

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TM 11-649

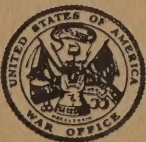
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TO 31R2-2FRR-221

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QU-157
R-390

RADIO RECEIVING SETS AN/FRR-40 AND AN/FRR-41



DEPARTMENTS OF THE ARMY AND THE AIR FORCE
SEPTEMBER 1955

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Single-sideband Converter CV-157/URR	265-volt dc and 115- to 230-volt ac
Radio Receiver R-390/URR	300-volt dc and 115- to 230-volt ac
Electrical Equipment Cabinet CY-1119/U	115- to 230-volt ac

DON'T TAKE CHANCES!

TECHNICAL MANUAL
No. 11-649
TECHNICAL ORDER
No. TO 31R2-2FRR-221

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., 28 September 1955

RADIO RECEIVING SETS AN/FRR-40 AND AN/FRR-41

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains information for the guidance and instruction of all concerned. It contains instructions necessary for the installation, operation, and maintenance of Radio Receiving Sets AN/FRR-40 and AN/FRR-41.

b. Radio Receiving set AN/FRR-40 consists of one Radio Receiver R-390/URR, one Single Sideband Converter CV-157/URR, one Electrical Equipment Cabinet CY-1119/U, and one installation kit.

c. Radio Receiving Set AN/FRR-41 consists of two Radio Receivers R-390/URR, two Single Sideband Converters CV-157/URR, one Electrical Equipment Cabinet CY-1119/U, and one installation kit.

d. A list of the nomenclature assignments for the components of Radio Receiving Sets AN/FRR-40 and AN/FRR-41 is given below. A common name is indicated after each item.

Nomenclature	Common name
Radio Receiving Set AN/FRR-40	AN/FRR-40
Radio Receiving Set AN/FRR-41	AN/FRR-41
Radio Receiver R-390/URR.....	Receiver
Single Sideband Converter CV-157/URR.	Converter
Electrical Equipment Cabinet CY-1119/U.	Cabinet
Installation kit for Radio Receiving Set AN/FRR-40.	AN/FRR-40 installation kit.
Installation kit for Radio Receiving Set AN/FRR-41.	AN/FRR-41 installation kit.

e. Comments on this publication should be forwarded directly to: Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, New Jersey, Attn: Standards Division.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and when performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Shipping Guide, Article 850-4 (Navy); and AFR 71-4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700-45-5.

c. DD Form 535, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AF TO 00-35D-54.

d. DA Form 11-238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 24).

e. DA Form 11-239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 25).

f. Use other forms and records as authorized.

RADIO RECEIVING SET
AN/FRR-40

RADIO RECEIVING SET
AN/FRR-41

RADIO
RECEIVER
R-390/URR

SINGLE
SIDEBAND
CONVERTER
CV-157/URR

RADIO
RECEIVER
R-390/URR

SINGLE
SIDEBAND
CONVERTER
CV-157/URR

ELECTRICAL
EQUIPMENT
CABINET
CY-11119/U

TM649-1

Figure 1. Radio Receiving Sets AN/FRR-40 and AN/FRR-41.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

(fig. 1)

a. Radio Receiving set AN/FRR-40 is intended primarily for the reception of single-sideband or twin single-sideband radio signals within the frequency of .5 to 32 megacycles (mc). Provisions are made in the equipment to receive this range of signals up to a 12-kilocycle (kc) bandwidth that carry multiplex teletypewriter, facsimile, and/or voice intelligence. In addition, the AN/FRR-40 is used to improve the reception of the amplitude-modulated (am) signals under conditions of extreme atmospheric interference.

b. Radio Receiving Set AN/FRR-41 is used for dual-diversity reception of the same types of signals as received by the AN/FRR-40 set. The AN/FRR-41 may also be used as two separate AN/FRR-40 receiving sets.

4. System Application

Both the AN/FRR-40 and AN/FRR-41 are used in long-haul applications between installations that have a heavy flow of message traffic. The audio output in each channel of the AN/FRR-40 or AN/FRR-41 may be used to operate voice reproducing equipment directly or may feed carrier terminal equipment. The terminal equipment will make possible the reception of several channels of teletypewriter or facsimile intelligence. Each of the output channels from the AN/FRR-40 or AN/FRR-41 corresponds to a pair of wires in a one-way landline voice-frequency multiplexing operation. When receiving a signal in which only one sideband contains intelligence, only one channel in each converter will have an output signal. This output may be used to operate as many channels of teletypewriter facsimile, or voice reproduction equipment as it is possible to operate from a corresponding pair of wires feeding a single carrier terminal equipment. When receiving a signal in which both sidebands contain separate intelligence, both channels of each converter will have an output signal. This doubles the amount of intelligence received.

a. Some system applications that the radio sets fit into are as follows:

- (1) Reception of from 1 through 12 channels of teletypewriter intelligence using two-tone converting equipment.

- (2) Reception of from 1 to 16 channels of teletypewriter intelligence using audio frequency-shift keying converting terminal equipment.
- (3) Reception of one or two channels of facsimile intelligence using converting terminal equipment and facsimile reproduction devices.
- (4) Reception of one or two channels of voice using audio reproducing devices (loudspeakers or headsets).
- (5) Reception of combinations of the above types of intelligence thus; one channel of voice and/or one channel of facsimile in conjunction with six-channel (two-tone) or eight-channel (audio frequency-shift keying) teletypewriter intelligence.

b. With the AN/FRR-41 operating as two AN/FRR-40 receivers, the above combinations of receivable information can be doubled. In a diversity setup, the AN/FRR-41 will handle the same quantity of intelligence as the AN/FRR-40. However, more reliable reception will be obtained.

c. Figure 2 shows a twin single-sideband receiving system that consists of an AN/FRR-40, terminal equipment, teletypewriter, and a loudspeaker or a headset. When facsimile operation is used, facsimile equipment will replace the teletypewriter. In the system shown on figure 2, the transmitted upper sideband (usb) has been formed by modulating the carrier with multiplex teletypewriter intelligence, while the transmitted lower sideband (lsb) carries a voice order wire. For two channels of voice operation, a loudspeaker will be connected at output A of the converter of the receiving set and the terminal equipment will be disconnected. When teletypewriter or facsimile intelligence is transmitted on both sidebands, two terminal equipments will be used in place of the loudspeakers. The terminal equipment translates the audio tones of the multiplex teletypewriter signal into the direct-current (dc) pulses necessary to run the receiving teletypewriter printers.

d. Figure 3 shows the AN/FRR-41 set up for space-diversity operation, which is the type of diversity operation most commonly used. In space diversity, a single transmitter and antenna are used at the sending end of the system, and two antennas separated by a distance of 600 feet (or more) are

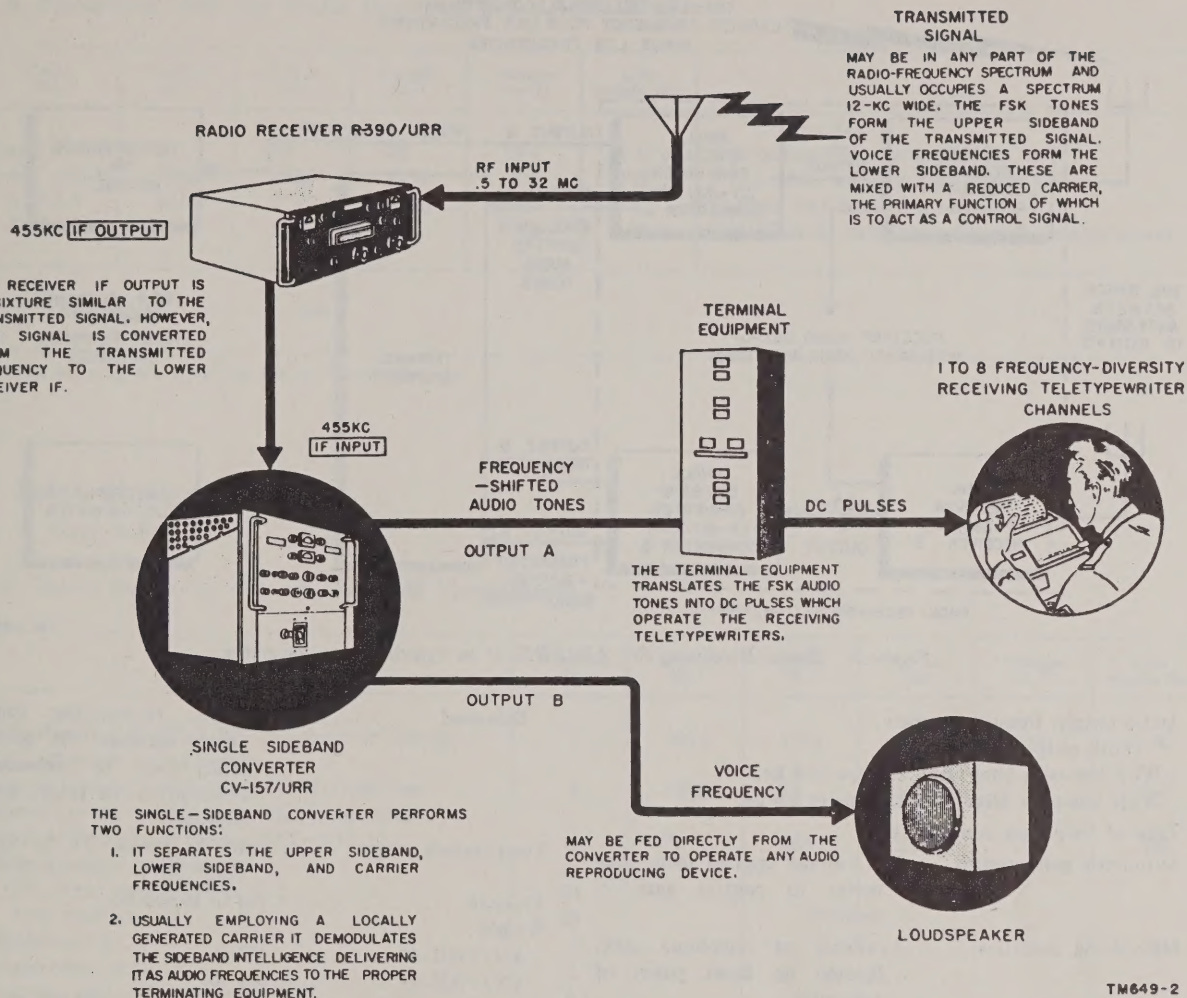


Figure 2. Radio Receiving Set AN/FRR-40 in typical radioteletype system.

used at the receiving end of the system. Each antenna is used to feed a separate receiver. The channel A outputs of both converters are fed to the terminal equipment. Here the outputs are compared and the stronger one becomes the output of the terminal equipment. The outputs (dc pulses) are then fed to the receiving teletypewriters. In the system as illustrated, the channel B output of converter B is unused since a satisfactory reception for voice intelligence may usually be obtained, as shown, with a single receiver and converter.

5. Technical Characteristics

Frequency range0.5-32 mc.

Types of signals received...Single-sideband and twin single-sideband.

Sensitivity:

Ssb signals1 uv or better.

Power source required....105- to 125-volt ac, 50- to 60-cycle, single-phase or 210- to 250-volt ac, 50- to 60-cycle, single-phase.

Power input:

AN/FRR-40520 watts total; 420 watts with receiver OVENS switch at OFF.

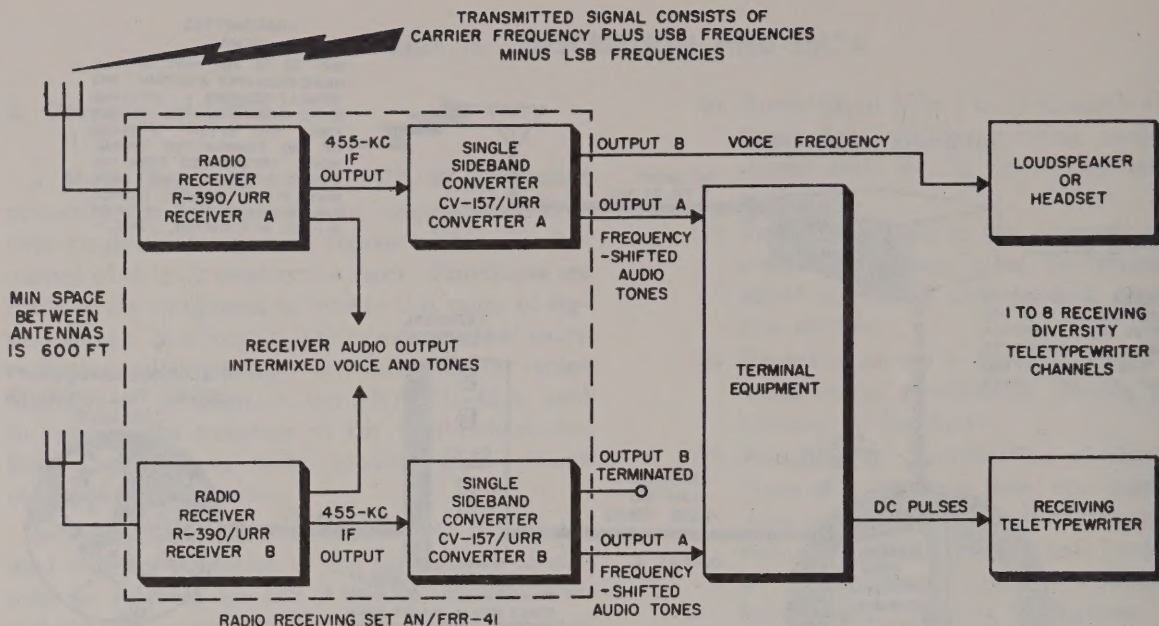
AN/FRR-411,040 watts total; 940 watts with receiver OVENS switch at OFF.

Number of output channels..2.

Output dataAudio output frequency across 600 ohms, available at terminal board TB1, located on rear of chassis.

Audio output level

(channels A and B).....Variable between 0 to 100 milliwatts w/5,000 microvolts or more input from receiver if.



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Figure 3. Radio Receiving Set AN/FRR-41 in typical space diversity.

Audio output frequency range

(both output channels):

With low-pass filter OUT..125 cps to 6 kc.

With low-pass filter IN..125 cps to 3.5 kc.

Type of frequency control..Afc.

Automatic gain control.....Afc voltage applied from converter to control gain in receiver.

Monitoring facilitiesAvailable at telephone jack, located on front panel of converter.

Squelch alarmOperates when signal-to-noise ratio falls below a predetermined level.

Drift alarmActuated just before afc control circuit has reached end of its corrective range.

Antennas:

UnbalancedRandom length vehicular-mounted whip or straight-wire.

Balanced125-ohm terminating impedance; matches 70- to 200-ohm lines or unbalanced transmission lines using adapters.

Temperature range-40° C (-40° F) to 55° C (131° F).

AltitudeUp to 10,000 ft.

Weight:

AN/FRR-40433 lb.

AN/FRR-41622 lb.

6. Packaging Data

When packaged for shipment, the components of Radio Receiving Sets AN/FRR-40 and AN/FRR-41 are placed in moisture-vaporproof containers and are packed in four and six wooden crates, respectively. The size, weight, and volume of each crate are indicated in the following charts.

Note. Items may be packaged in a manner different from that shown depending on the supply channel.

a. Packaging Data for Radio Receiving Set AN/FRR-40.

Crate No.	Height (in.)	Width (in.)	Length (in.)	Volume (cu ft)	Unit weight (lb)	Contents
1 of 4	21	32	32	12.4	100	Receiver with running spares *
2 of 4	25 $\frac{1}{4}$	22 $\frac{3}{4}$	22 $\frac{3}{4}$	7.6	162	Converter with running spares *
3 of 4	26 $\frac{3}{4}$	27 $\frac{1}{2}$	81 $\frac{1}{2}$	34.2	335	Cabinet and mounting screws.
4 of 4	6 $\frac{1}{4}$	14 $\frac{1}{2}$	23	1.1	45	AN/FRR-40 installation kit with running spares *.

Total weight.....642

* Refer to paragraph 12 for the list of running spares.

b. Packaging Data for Radio Receiving Set AN/FRR-41.

Crate No.	Height (in.)	Width (in.)	Length (in.)	Volume (cu ft)	Unit weight (lb)	Contents
1 and 2 of 6	21	32	32	12.4	100	2 Receiver with running spares ^a .
3 and 4 of 6	25¼	22¾	22¾	7.6	162	2 Converter with running spares ^a .
5 of 6	26¾	27½	81½	34.2	335	Cabinet and mounting screws.
6 of 6	6¼	14½	23	1.1	50	AN/FRR-41 installation kit with running spares ^a .

Total weight.....909

^a Refer to paragraph 12 for the list of running spares.

7. Table of Components

(figs. 4 and 5)

a. Radio Receiving Set AN/FRR-40 Components.

Component	Required No.	Height (in.)	Depth (in.)	Width (in.)	Volume (cu ft)	Unit weight (lb)
Radio Receiver R-390/URR (see receiver manual for individual components).	1	10½	17¼	19	2.0	80
Single Sideboard Converter CV-157/URR (see converter manual for individual components).	1	15¾	15	19	2.6	104
Electrical Equipment Cabinet CY-1119/U.....	1	76	20½	21¾	19.7	225
Miscellaneous hardware:						
Ovalhead screws (12-24).....	60					
Cup washers.....	60					
Installation kit:	1					24
Nameplate, N1101.....	1					
Caution plate, N1102.....	1					
Fuses, 10-amp, 125-volt, F1101 and F1102.....	2					
Blank panel set:						
Size A, A 1105.....	1	1¾		19		
Size C, A 1106.....	1	5¼		19		
Size G, A 1107, A 1108, and A 1109.....	3	12¼		19		
Miscellaneous hardware set:	1					
Slotted bindinghead machine screws (H1101) 2-56 x ¾ in.....	8					
Slotted roundhead machine screws (H1102) ¼-20 x 5/8 in.....	8					
Flat washers, H1106, ¼ in. id, 5/8 in. od.....	8					
Split lock washers, H1107, ¼ in.....	8					
Square nuts, H1105, ¼-20.....	8					
Plug Connector UG-573/U, P1101.....	1					
Connector, Adapter UG-971/U, CP1101.....	1					
Angle brackets, A 1101 through A 1104.....	4	1¾	19	1¼		
Ground straps:						
W1101.....	1		16	¾		
W1102.....	1		5	¾		
Running spares (par. 12).....						12

Total weight.....445

b. Radio Receiving Set AN/FRR-41 Components.

Component	Required No.	Height (in.)	Depth (in.)	Width (in.)	Volume (cu ft)	Unit weight (lb)
Radio Receiver R-390/URR (see receiver manual for individual components).	2	10½	17¼	19	2.0	80
Single Sideband Converter CV-157/URR (see converter manual for individual components).	2	15¾	15	19	2.6	104
Electrical Equipment Cabinet CY-1119/U.....	1	76	20½	21¾	19.7	225
Miscellaneous hardware:						
Ovalhead screws (12-24).....	60					
Cup washers.....	60					
Installation kit:	1					29
Nameplate, N1201.....	1					
Caution plate, N1202.....	1					
Fuses, 15-amp, 125-volt, F1201 and F1202.....	2					
Blank panel Set:						
Size A, A 1209, A 1210 and A 1211.....	3	1½		19		
Size B, A 1212 and A 1213.....	2	3½		19		
Size C, A 1214.....	1	5¼		19		
Miscellaneous hardware set:						
Slotted bindinghead machine screws, H1201, 2-56 x ¾ in.....	8					
Slotted roundhead machine screws, H1202, ¼-20 x ½ in.....	16					
Flat washers, H1206, ¼ in. id, ⅝ in. od.....	16					
Split lock washers, H1207, ¼ in.....	16					
Square nuts, H1205, ¼-20.....	16					
Plug Connector UG-573/U, P 1201 and P 1202.....	2					
Connector, Adapter UG-971/U, CP 1201 and CP 1202.....	2					
Angle brackets, A 1201 through A 1208.....	8	1¾	19	1¼		
Ground straps:						
W1201 and W1202.....	4		5	⅝		
W1204 and W1203.....	1		16	⅝		
Running spares (par. 12).....						24

Total weight.....646

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

8. Description of Radio Receiver R-390/URR (fig. 4)

The receiver contains a relay rack-type front panel with handles, for easy mounting to the cabinet. All operating controls are located on this panel, which has a gray semigloss finish. The back panel contains the terminal strips and receiver intermediate-frequency (if) output jack necessary for operation with the converter unit. Jacks are also provided on the back panel for connections to an antenna. The receiver uses Power Cable Assembly CX-1358/U for connection to the alternating-current (ac) power source. A screw-locking plug is provided at the receiver end of the cable to provide a tight connection.

9. Description of Single Sideband Converter CV-157/URR (fig. 4)

The converter has a gray aluminium alloy front panel containing all of the operating controls, the MONITOR jack, and the meters of the unit. The input and output connections are made on the back panel of the converter. The converter is divided into a base assembly and a drawer assembly. Most of the components are contained in the drawer assembly that can be extended from the base assembly on *filing cabinet* type drawer slides. This feature enables much of the converter testing to be accomplished without removal from the rack mount. All interconnecting cables may remain in place, and

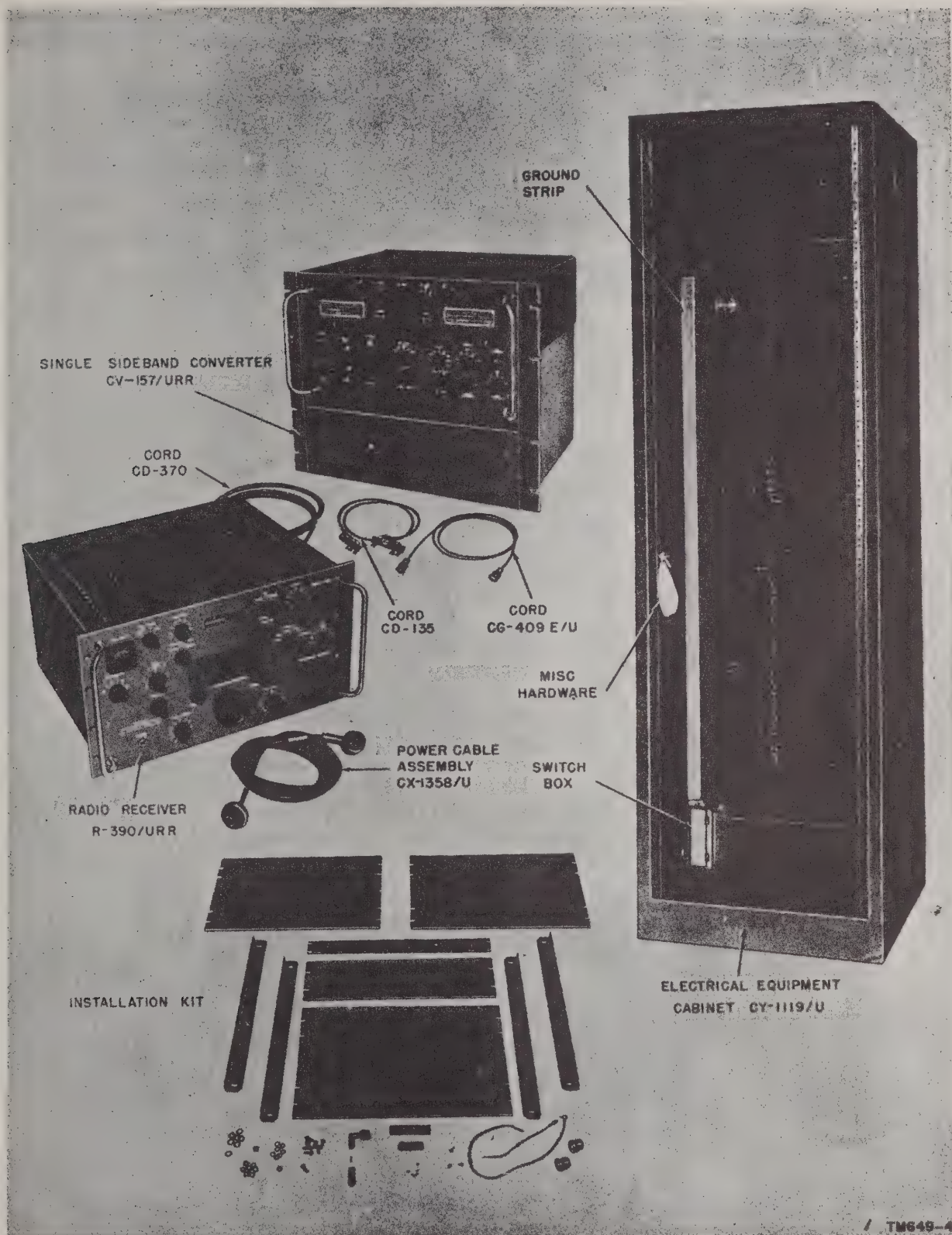
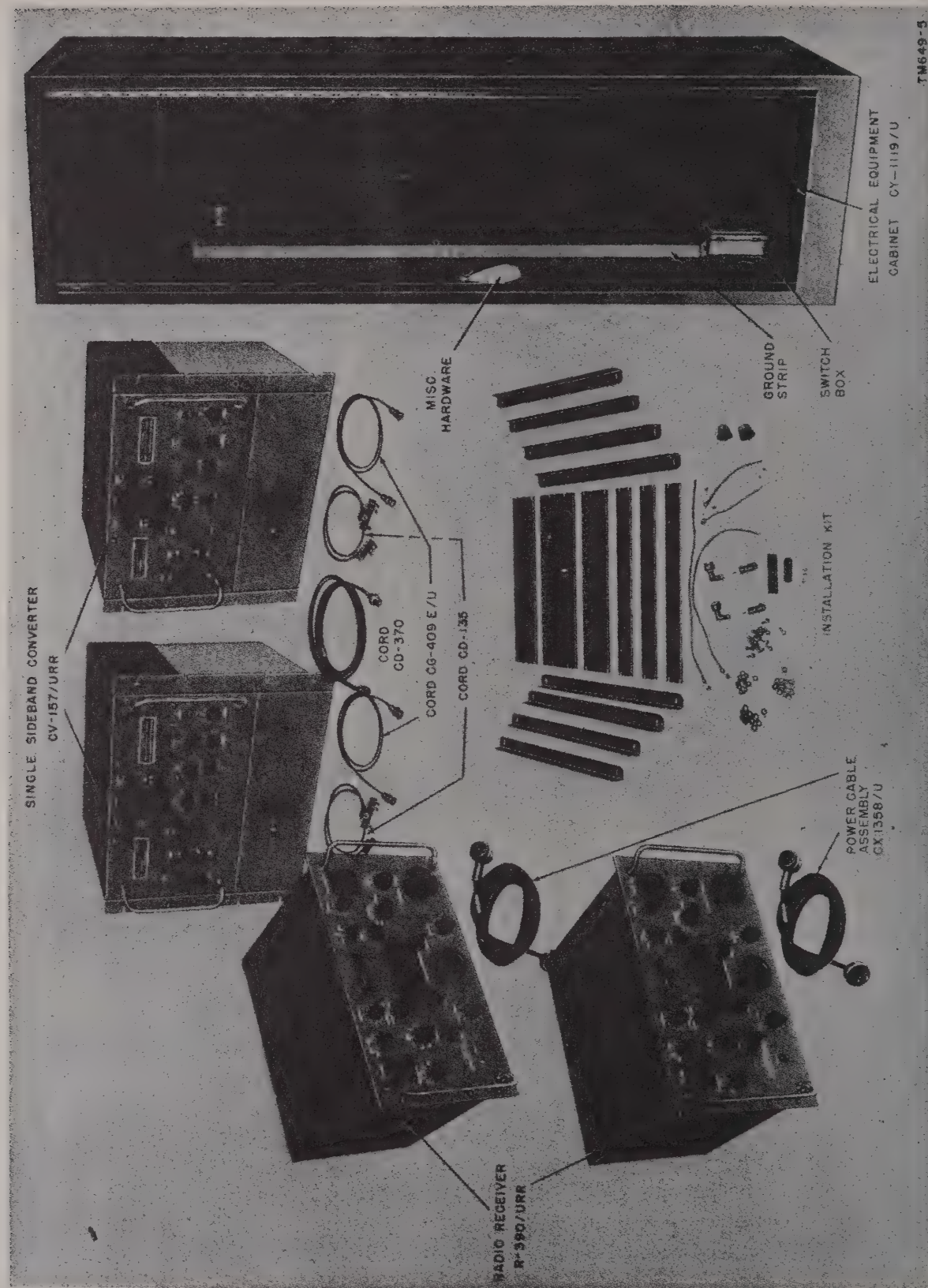


Figure 4. Radio Receiving Set AN/FRR-40, components.



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Figure 5. Radio Receiving Set AN/FRR-41, components.

the various adjustments for alinement may be made while the converter is extended from the cabinet. Cord CD-370, Cord CD-135, and Cord CG-409E/U are included as part of Single Sideband Converter CV-157/URR.

10. Description of Electrical Equipment Cabinet CY-1119/U (fig. 4)

Electrical Equipment Cabinet CY-1119/U is a gray relay rack-type cabinet. Mounting screws for the units of the radio receiving set are secured in tapped holes in vertical rack channels on either side of the front opening of the cabinet. The cabinet is provided with a switch box containing a power switch and fuse receptacles and an eight-receptacle strip to provide easy access to a power source for the components. On the opposite side of the cabinet is a common ground bus, which contains tapped holes to provide a means of securing ground straps from the various units of the radio receiving set. The cabinet has a latched door at its rear through which the various interconnections of the components are readily accessible. The top of the cabinet is partially screened to provide ventilation, and a dust cover over the screening prevents dust from settling over the equipment. The cabinet is equipped with six access openings (two on each side panel and two on the top panel), which provide entrance for cables from outside sources, such as antenna transmission lines, power cables, etc. The cover plates may be removed from the openings by removing the four bolts that hold each cover plate in place.

11. Description of Installation Kits (figs. 4 and 5)

The installation kits for Radio Receiving Sets AN/FRR-40 and AN/FRR-41 consist of the connectors, brackets, blank panels, hardware, and fuses that are necessary to install the components of each equipment in its cabinet as an operating unit. The manuals (not shown in figures) containing instructions for installation, operation, maintenance, and

repair of both receiving sets are also included in the installation kit.

12. Running Spares

A group of running spares has been packed separately with each receiver, converter, and installation kit, making a complete AN/FRR-40 and AN/FRR-41 assembly. There are spares for all normally expendable items, such as tubes, pilot lamps, fuses, and connectors. A list of running spares packed with *each* of the components for Radio Receiving Sets AN/FRR-40 and AN/FRR-41 is shown in the following table:

Component	Running spares (one set each)
Radio Receiver R-390/URR.	Refer to receiver manual (TM11-856).
Single Sideband Converter CV-157/URR.	Refer to converter manual.
Installation kit for Radio Receiving Set AN/FRR-40.	1 Plug Connector UG-573/U. 1 Connector Adapter UG-971/U. 12 fuses, 10-ampere type F14-D-10ROA.
Installation kit for Radio Receiving Set AN/FRR-41.	1 Plug Connector UG-573/U. 1 Connector, Adapter UG-971/U. 12 fuses, 15-ampere type F14-D-15ROA.

13. Additional Equipment Required

The receiving set is part of a complete radio-teletype receiving system and other components of the system (besides an ac power source) are required for set operation. A typical receiving system would include the following additional equipment:

- Carrier terminal equipment.
- Receiving teletypewriters or facsimile reproducers.
- Antenna and transmission line equipment.
- Headsets.
- Loudspeakers.

CHAPTER 2

INSTALLATION

Section I. SERVICE UPON RECEIPT OF RADIO RECEIVING SETS

AN/FRR-40 AND AN/FRR-41

14. Siting

(figs. 6 and 7)

a. Exterior Requirements. The prime consideration for the location of any radio equipment is the siting of its antennas. If possible, site the antennas in a position where the immediate terrain is fairly level, and the ground has good conductive properties. If possible, locate the antennas in such a way that nearby hills, densely wooded areas, and other obstructions are not in a line with the receiving antennas and the station from which signals are being received. Do not locate the antennas near overhead power lines, steel bridges, or other metallic structures. The equipment should be housed in the best building available. Avoid locations where drainage conditions may lead to flooding the shelter.

- (1) Two receiving antennas are required when using the AN/FRR-41 in space-diversity operation. An area clear of the obstacles mentioned above will be suitable for erection of the two antennas. These antennas should be no less than 600 feet apart and oriented in relation to the direction of the received signal, to take advantage of their directional properties. Two common types of receiving antennas, the double-doublet (A, fig. 7) and the horizontal rhombic (B, fig. 7), are shown set up for operation in a space-diversity system.
- (2) A satisfactory double-doublet antenna is described in TM 11-2629, Antenna Kit for Double-Doublet Receiving Antenna. A horizontal rhombic antenna, generally more efficient than any form of doublet, is described in TM 11-2611, Antenna Kit for Rhombic Receiving Antenna. To prevent interference from transmitting antennas,

the receiving shelter should be located several miles from the transmitting shelter.

b. Interior Requirements. This equipment is designed for operation in a fixed installation. Electrical Equipment Cabinet CY-1119/U will not withstand the shocks and severe vibration to which a mobile installation is subjected, although the receiver and converter components of the equipment will. The shelter for fixed installation must meet the following requirements:

- (1) Floor ducts should be provided for the installation of antenna cables and power cables.
- (2) The flooring under the equipment must be suitable for allowing mounting studs to be used to secure the equipment in its place of installation, because the converter is extended on *filing cabinet* type drawer slides for servicing. With the converter in this position, the equipment becomes unstable and should be fastened down to prevent damage to the equipment or injury to the operating personnel.
- (3) Adequate lighting for day and night operation must be provided. Position the equipment so that the panel designations can be read easily by the operator. Artificial lighting should be installed so that the light falls directly on the front panels of the receiver and converter components. A portable drop lamp and extension cord are convenient for maintenance personnel.
- (4) Adequate ventilation must be provided.
- (5) Sufficient space must be allowed behind the cabinet to open the door, and sufficient space must be provided on one side so that it is possible to walk to the rear of the cabinet.

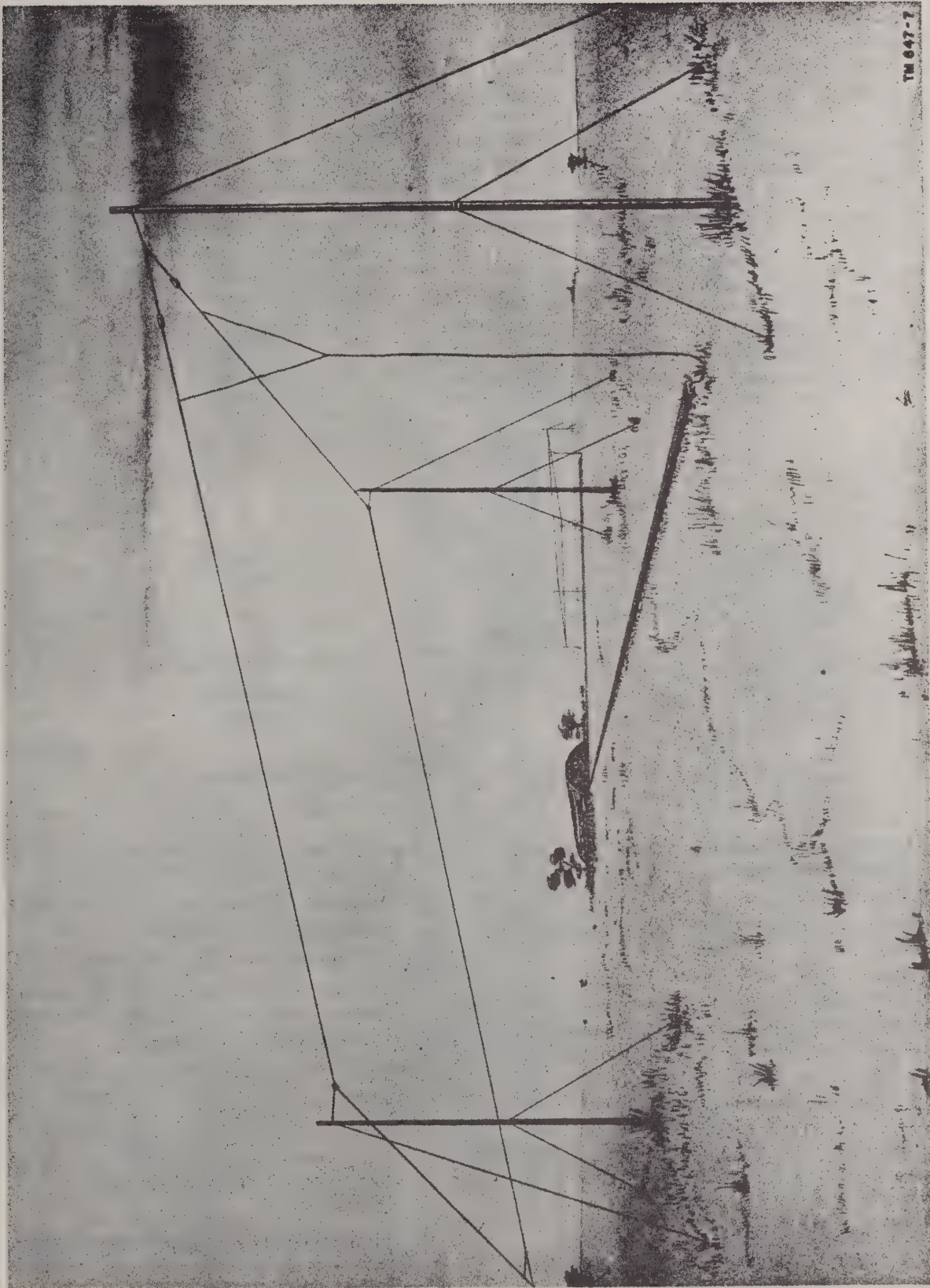


Figure 6. Siting Radio Receiving Sets AN/FRR-40 and AN/FRR-41.

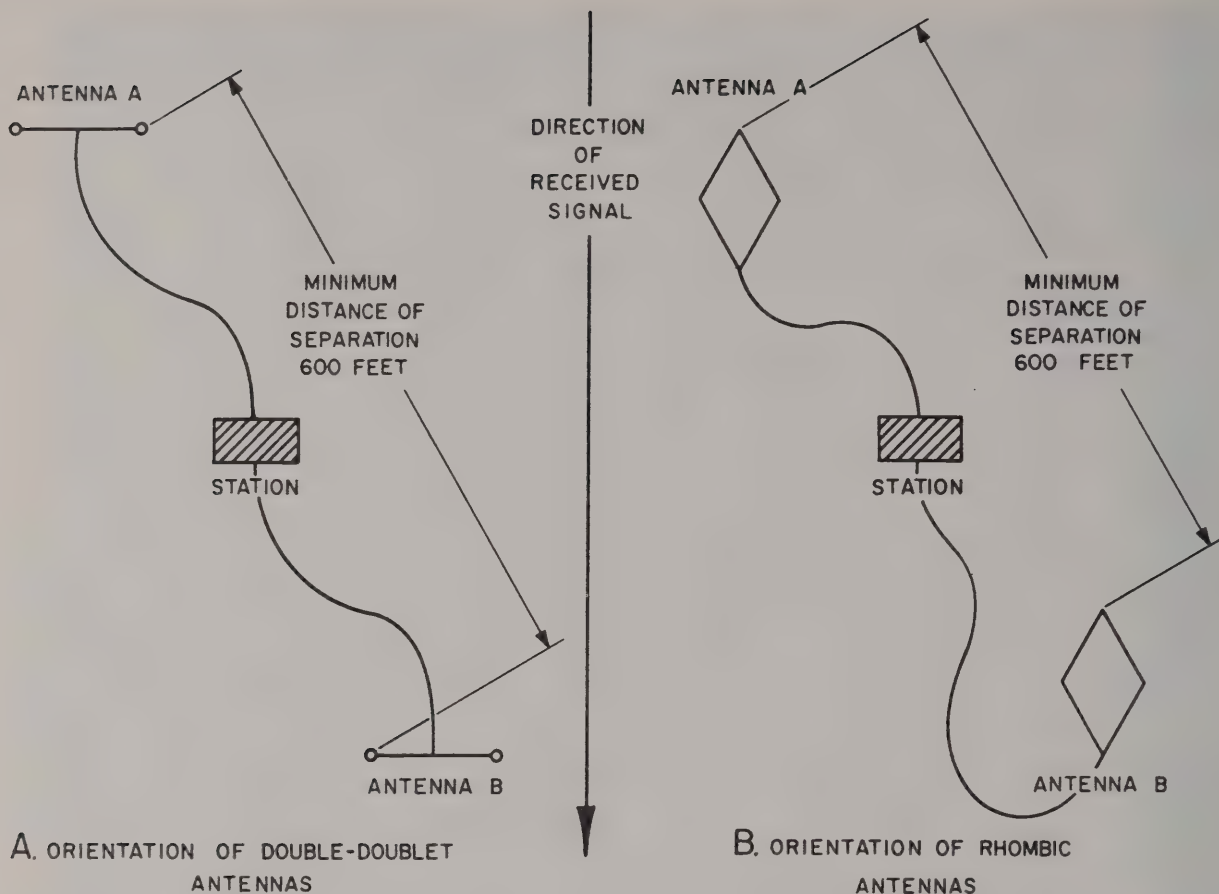


Figure 7. Orientation and positioning of antennas for space-diversity reception.

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15. Uncrating, Unpacking, and Checking New Equipment

(figs. 8 and 9)

Note. For used or reconditioned equipment, refer to paragraph 21.

a. General. There are four different packages for the AN/FRR-40 and six for the AN/FRR-41. The instructions in this paragraph apply to two packages in each set: Electrical Equipment Cabinet CY-1119/U and the installation kit for the receiving sets. Refer to the component manuals for instructions pertaining to the receiver and converter. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is convenient for permanent or semipermanent installation.

Caution: Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged.

b. Step-by-Step Instructions for Unpacking Electrical Equipment Cabinet CY-1119/U (fig. 8).

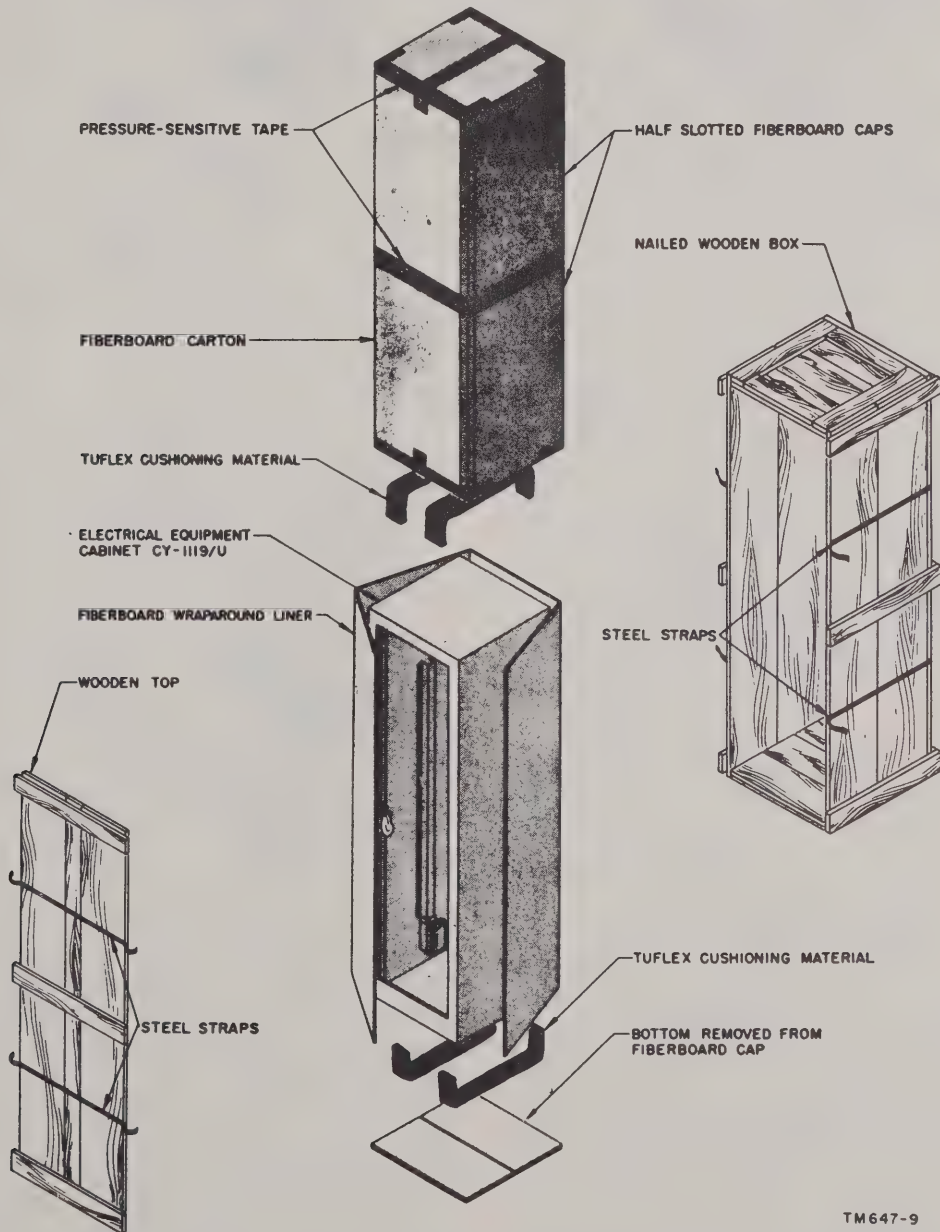
- (1) Place the packing case as near the operating position as convenient.
- (2) Cut and fold back the steel straps.
- (3) Remove the nails from the top with a nail puller and remove the top. Do not attempt to pry off the sides or ends.
- (4) Stand the case on end and slide the fiberboard-covered cabinet out of the case.
- (5) With a sharp knife, slit through the fiberboard carton along the edges around the base; then lift the carton upward until it is off the cabinet.
- (6) Slit through the fiberboard liner along the vertically taped edge; then peel the liner away from the cabinet.

- (7) Inspect the cabinet for possible damage. Open and close the switch box and rear door panels to check for smooth operation.
- (8) Check the contents of the packing case against the master packing slip.

c. Step-by-Step Instructions for Unpacking Installation Kits for Radio Receiving Sets AN/FRR-40 and AN/FRR-41 (fig. 9).

- (1) Place the packing case as near the operating position as convenient.

- (2) Cut and fold back the steel straps.
- (3) Remove the nails from the top with a nail puller and remove the top. Do not attempt to pry off the sides.
- (4) Open the top of the inner (fiberboard) carton and remove the waterproof paper bags. Remove the angle brackets and the blank panels.
- (5) Open the waterproof paper bags; then check the contents of the packing case against the master packing slip.



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Figure 8. Packing and packaging of Electrical Equipment Cabinet CY-1119/U.

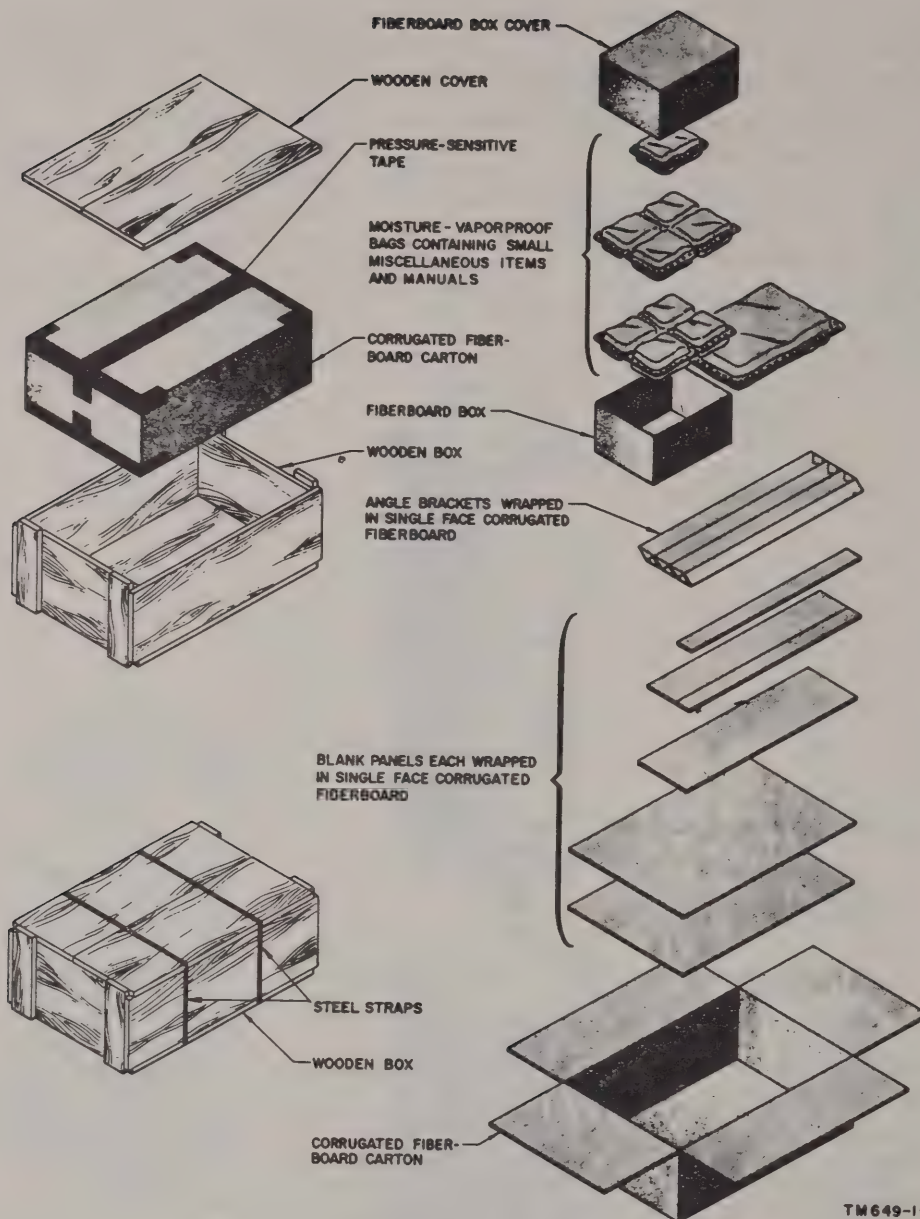


Figure 9. Packing and packaging of installation kit.

TW649-11

16. Preinstallation Adjustments

Before installing the receiver and converter components in the cabinet, certain adjustments must be made. Place the components on a bench with the test equipment, as shown in figure 11, and connect them to the ac power source. Use Power Cable Assembly CX-1358/U for the receiver and Cord CD-370 for the converter (fig. 5). Turn on the test equipment.

a. Ac Input Power Adjustment. Both the AN/FRR-40 and the AN/FRR-41 are delivered

preset and equipped for operation from a 115-volt ac source. To change the equipment over for 230-volt ac operation, refer to the component manuals for proper instructions. Be sure that 5-ampere fuses are substituted for the 10-ampere fuses used in the AN/FRR-40 cabinet and 8-ampere fuses are substituted for the 15-ampere fuses used in the AN/FRR-41 cabinet when the equipment is on 230-volt ac operation (fig. 19).

b. Presetting Radio Receiver R-390/URR.

(1) Set the OVENS switch (on rear) as follows:

- (a) At OFF, when operation is in a temperature-regulated building.
- (b) At ON, when operation is in a location subject to variations in temperature or operating under low-temperature conditions.

- (2) Turn on the receiver by turning the FUNCTION switch (fig. 13) to STAND BY and allow it to warm up for approximately 15 minutes.

c. Calibrating Radio Receiver R-390/URR.

When receiving single-sideband or twin single-sideband signals, it is necessary that the receiver be tuned exactly to the carrier frequency. Perform the following procedures:

- (1) Set the front panel controls (fig. 13) as follows:

Control	Position
BANDWIDTH switch1 KC
AUDIO RESPONSE switch.....	MED.
RF GAIN control.....	10
BFO switch	ON
FUNCTION switch	CAL
LIMITER control	OFF

- (2) Turn the MEGACYCLE CHANGE control to the correct frequency band.
- (3) Turn the KILOCYCLE CHANGE control for a reading on the frequency indicator at the 100-kc point nearest the frequency desired for reception.
- (4) Turn the ZERO ADJ. clockwise as far as it will go.
- (5) Rotate the ANT. TRIM until a maximum indication on the CARRIER LEVEL meter appears.
- (6) Adjust the KILOCYCLE CHANGE control for maximum indication on the CARRIER LEVEL meter. Maximum indication should be obtained with only a slight adjustment of the control in either direction. If a maximum reading is not obtained within the limits of travel of the KILOCYCLE CHANGE control, as set by the ZERO ADJ. control, the variable frequency oscillator (vfo) tuning shaft must be synchronized by following the instructions in the manual covering the receiver.
- (7) Turn the BFO PITCH control to produce zero beat. If the BFO PITCH control fails

to produce a zero beat at a reading of 0 on its scale, loosen the set screw at the base of its control knob, and set the pointer at 0; then tighten the set screw.

- (8) Turn the ZERO ADJ. control counterclockwise to the stop. The dial and beat-frequency oscillator (bfo) now are calibrated accurately.
- (9) Turn the KILOCYCLE CHANGE control to the desired transmitted frequency.

d. Presetting Single Sideband Converter CV-157/URR.

- (1) Set the LOW PASS FILTER switch (fig. 10) as follows:
 - (a) Set at OUT for normal operation (6-kc bandwidth).
 - (b) Set at IN when receiving signals that contain audio tones up to a 3.5-kc bandwidth.
- (2) Turn on the converter by throwing the power switch to ON (fig. 14) and allow it to warm up for approximately 15 minutes.

e. Converter INPUT GAIN Adjustment R2 (fig. 10). Proper adjustment of the INPUT GAIN control is necessary to provide the converter circuits with the levels required for optimum performance, including correct automatic gain control (agc) characteristics and minimum distortion in the output signal. The input level requirements of the converter are met through the adjustment of INPUT GAIN control R2. Once this level is established, it is maintained virtually constant by the converter agc circuits. Set the INPUT GAIN control as follows:

- (1) Connect Signal Generator AN/URM-25 (fig. 11, omit the 75-ohm resistor shown), to the input impedance of the converter, at IF INPUT jack (fig. 11 or 12).
- (2) Adjust the generator to deliver a 455-kc unmodulated output signal of 5,000 microvolts (uv) to the converter.
- (3) Turn the CARRIER COMPENSATOR control (fig. 14) to 6.5.
- (4) Set the INPUT GAIN control to maximum.

Caution: If the needle of the converter CARRIER LEVEL meter hits the pin, back off the gain control.

- (5) Turn the AFC switch to ON (fig. 14).
- (6) Adjust the INPUT GAIN control for a midscale reading of 10 on the CARRIER

LEVEL meter. This setting should not be changed during subsequent adjustment of the age circuits.

f. AGC OUTPUT and AGC THRESHOLD Adjustment. The age characteristics of each converter must be matched with those of its associated receiver if the input signal to the converter is to be held constant. In the AN/FRR-41, the receivers and converters should be tagged or marked so that the matched components are connected together when installed in the cabinet. To perform this adjustment, proceed as follows:

Note. The converters, as delivered, have the carrier and sideband age circuits equalized. This equalization adjustment is established by the setting of capacitor C94 located at the rear of the converter (fig. 12). To check the equalization of these circuits, follow the procedure given in the manual for the Single Sideband Converter CV-157/URR.

(1) Connect the if. output of Radio Receiver R-390/URR to the if. input of the converter by means of Cord CG-409E/U for the 455-kc if signal transfer and age Cord CD-135 for age action (fig. 11). Tune the receiver to 4,000 kc.

(2) Set the receiver controls as follows (fig. 13):

Control	Setting
BFO switch	OFF
AGC switch	FAST
FUNCTION switch	AGC
BANDWIDTH switch	8 KC
RF GAIN control.....	Maximum
Setting of the remainder of the controls does not affect this adjustment.	

(3) Set the converter as listed below (fig. 14):

Control	Setting
MONITOR switch	OFF
MONITOR GAIN control.....	Zero
A-VC control	Midposition
B-VC control	Midposition
SB SELECT switch.....	LSB-B, USB-A
VU SELECT switch.....	OFF
VU RANGE switch.....	+10 DB
SQUELCH switch	OFF
AFC switch	OFF
AGC SELECT switch.....	REC
CARRIER SELECT switch.....	LC
SB AGC control.....	7.5
AGC TIME switch.....	MED
VERNIER control	0 KC
CARRIER COMPENSATOR control.....	6.5
DRIFT INDICATOR control.....	0 KC

Note. In setting the VERNIER control, place the indicating line of the disk and that of the knob at 0.

(4) Connect Signal Generator AN/URM-25 (fig. 11), modified to represent a 125-ohm source, between one of the terminals of receiver jack J108 balanced 125 ohm and ground. A 50-ohm signal generator may be provided with a 75-ohm series resistor to provide a 125-ohm source impedance.

(5) Connect the electronic multimeter (fig. 11) adjusted to measure negative dc voltage between ground and terminal 7 of TB2 (fig. 12) on the converter. With the signal generator tuned to assimilate a SIDEBAND frequency of 4,003 kc, increase its output from zero while observing the receiver age voltage indicated by the electronic multimeter. When the measured voltage increases by approximately .25 volt, the receiver age circuit becomes effective. This should occur with a signal input of only a few microvolts if the receiver sensitivity is normal. Note the signal generator output voltage at this point.

(6) With the AGC SELECT switch in the REC position, increase the signal generator output to 550 millivolts. This simulates the amplitude of the composite signal in the receiver age circuit. Note the voltage measured on the electronic multimeter. This is the age voltage developed by the receiver.

(7) Reduce the signal generator output to 500 millivolts. This simulates the amplitude of the composite signal in one sideband channel of the converter. Individual channels act on the converter sideband age circuit separately. Set the AGC SELECT switch to the USB position. Adjust AGC OUTPUT control R228 for a voltage reading of 1 volt greater than the reading on electronic multimeter in (6) above. AGC OUTPUT control R228 is on the rear chassis apron of the converter (fig. 12).

Note. On some units because of differences existing between acceptable tubes, it may not be possible to obtain this higher dc level. These units should be adjusted so that the minimum

level obtained in this step is at least equal to the receiver age voltage measured in (6) above.

- (8) Reduce the signal generator output to the value noted in (5) above. Set the converter AGC SELECT switch to the REC position. Note the voltage measured on the electronic multimeter. This is the age voltage developed by the receiver at the threshold point of age action. It is developed as a result of a composite input signal.
- (9) Reduce the signal generator output to 90 percent of the value noted in (5) above. This simulates the amplitude of the composite signal in one sideband channel of the converter. The converter sideband age voltage is a function of the energy that is filtered into one sideband channel. Set the converter AGC SELECT switch to the LSB position. Adjust AGC THRESHOLD control R231 for the same voltage reading on the electronic multimeter according to instructions in (8) above. Control R231 is located on the rear apron of the converter chassis (fig. 12).
- (10) Repeat the procedures outlined in (6) and (7) above, adjusting the AGC OUTPUT control. Repeat the procedures outlined in (8) and (9) above, adjusting the AGC THRESHOLD control.

g. Converter A-VC, B-VC Adjustments (fig. 14).

The volume control adjustments are made with the audio output of the converter feeding terminal equipment. The input requirements of the terminal equipment must be determined by consulting the manual that covers that particular equipment. Loss or gain in interconnecting pads, long lines, or amplifiers must be considered in determining the output requirements of the converter.

- (1) With the terminal equipment connected for normal operation, use a test setup as outlined in *d(4)* above. Set the converter controls as indicated in *d(3)* above and set the converter VU RANGE switch to

the value determined by the operating conditions.

- (2) Adjust the signal generator output for 1,000 microvolts at 4,003 kc. Set AGC SELECT switch to the USB position. Set the converter VU SELECT switch to A, and adjust the A-VC control for a VU METER reading determined by the operating conditions.
- (3) Adjust the signal generator output for 1,000 microvolts at 3,997 kc. Set the AGC SELECT switch to the LSB position. Set the converter VU SELECT switch to B, and adjust the B-VC control for a VU METER reading determined by the operating conditions.

h. Pretuning the Converter (fig. 14). Although Radio Receiver R-390/URR has a 455-kc if. the exact value of the center frequency of the pass band of a particular receiver (when its BANDWIDTH switch is in the 16 KC position) may be as much as 1,000 cycles per second (cps) removed from this value. To assure proper centering of the if. and prevent sideband clipping, adjust the heterodyne oscillator of the converter in accordance with the following instructions:

- (1) Connect Signal Generator AN/URM-25 as described in *d(4)*.
- (2) On the receiver, set the BANDWIDTH switch to the 16 KC position and the FUNCTION switch to AGC (fig. 13).
- (3) On the converter, set the AGC SELECT switch to the REC position, the AFC switch to OFF, the VERNIER and DRIFT INDICATOR controls to 0 KC, and the RANGE COMPENSATOR control C8 (fig. 10) to 9 (corresponds to 455 KC).
- (4) Apply an unmodulated signal, at any convenient frequency, to the receiver and tune for a maximum reading on the receiver CARRIER LEVEL meter (fig. 13).
- (5) Adjust the output of the signal generator until the meter reads approximately 66.

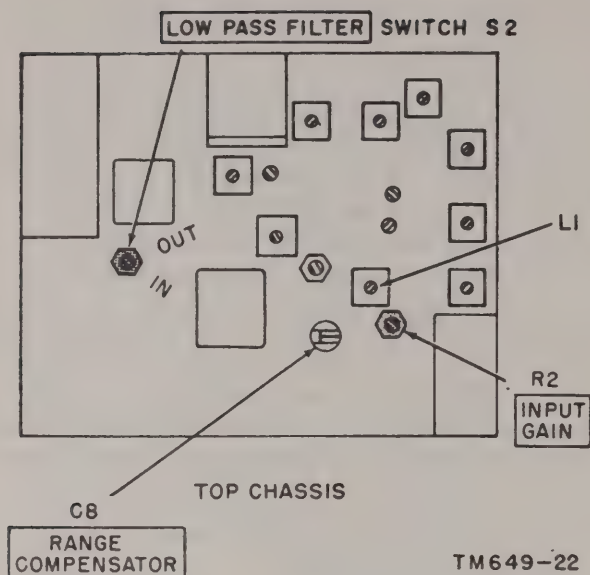


Figure 10. Top chassis view of converter.

- (6) Vary the KILOCYCLE CHANGE control on the receiver in both directions and note the dial readings at the two points where the meter reads 60 (fig. 13).
- (7) Set the KILOCYCLE CHANGE control to the exact arithmetical center between these two readings.

- (8) Adjust the tuning slug of the converter heterodyne oscillator coil (L1, fig. 10) until the if. signal output of the receiver falls into the carrier channel and causes the converter CARRIER LEVEL meter to deflect to the right.
- (9) The level of the signal applied from the signal generator should be set so that the CARRIER LEVEL meter is approximately half-scale when this adjustment is made.

Note. When tightening the locking nut on the coil slug of L1, be sure not to turn the slug and thus detune the stage. Should the coil detune slightly in tightening the locking nut, the RANGE COMPENSATOR control may be used for minor adjustments of this nature. Adjust the RANGE COMPENSATOR control for the midscale reading as obtained in *h* above. This adjustment should not be considered the normal tuning of the heterodyne oscillator stage; for complete alinement of the heterodyne oscillator stage, refer to the converter manual.

i. Disassembling Equipment. Turn off all the power switches to the equipment used above and remove the cables connected to the receiver and converter. The radio set is now ready to be installed.

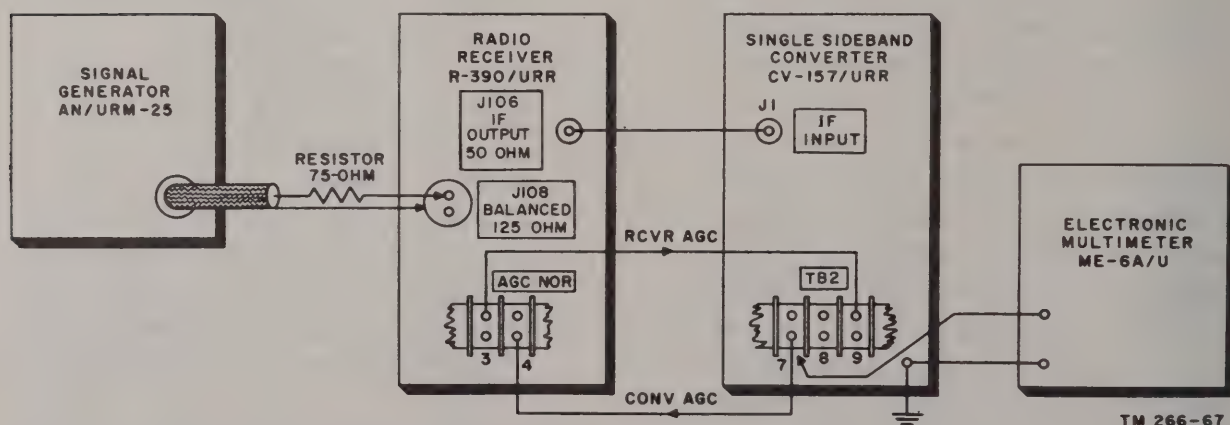


Figure 11. Setup for preinstallation adjustments.

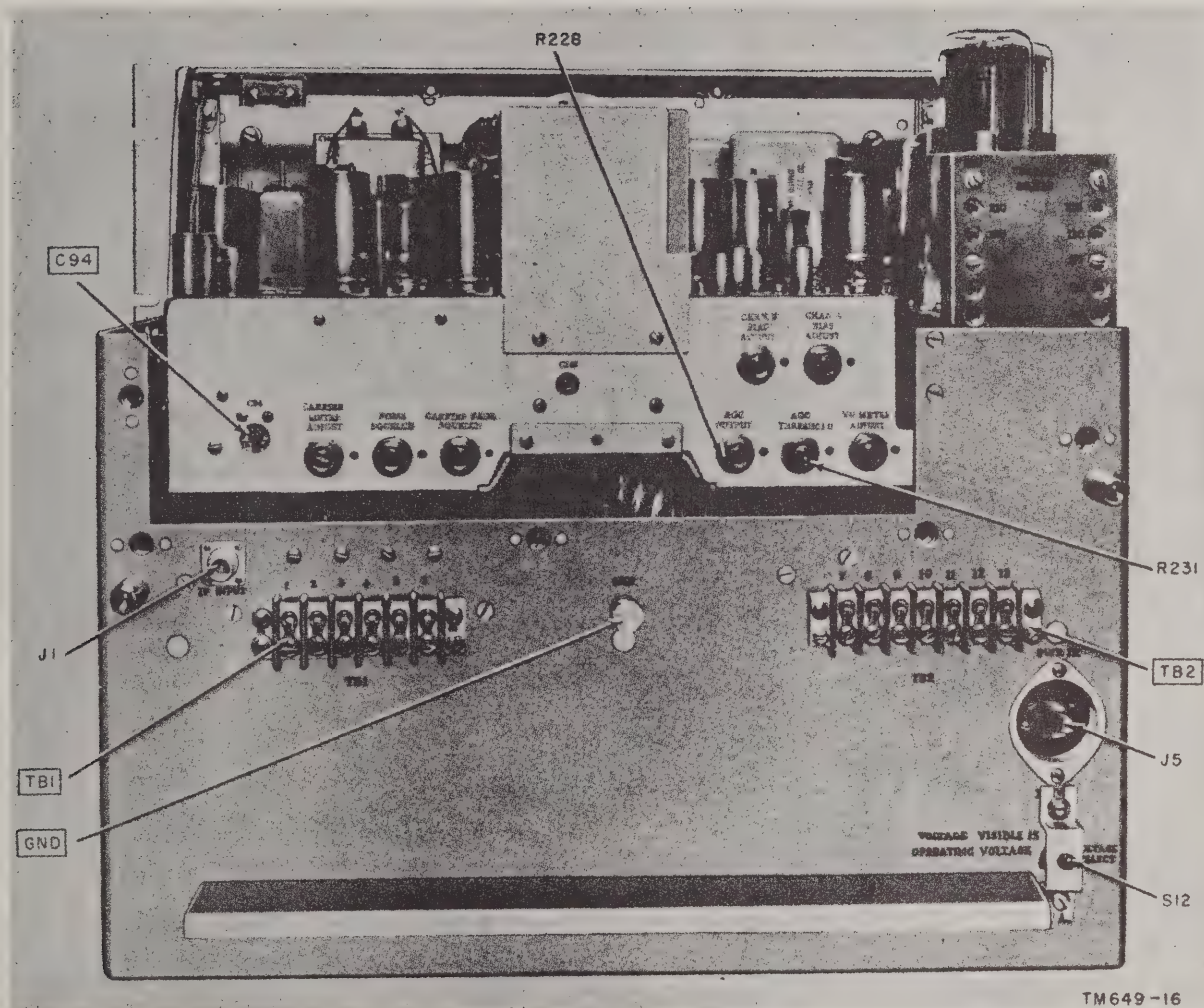
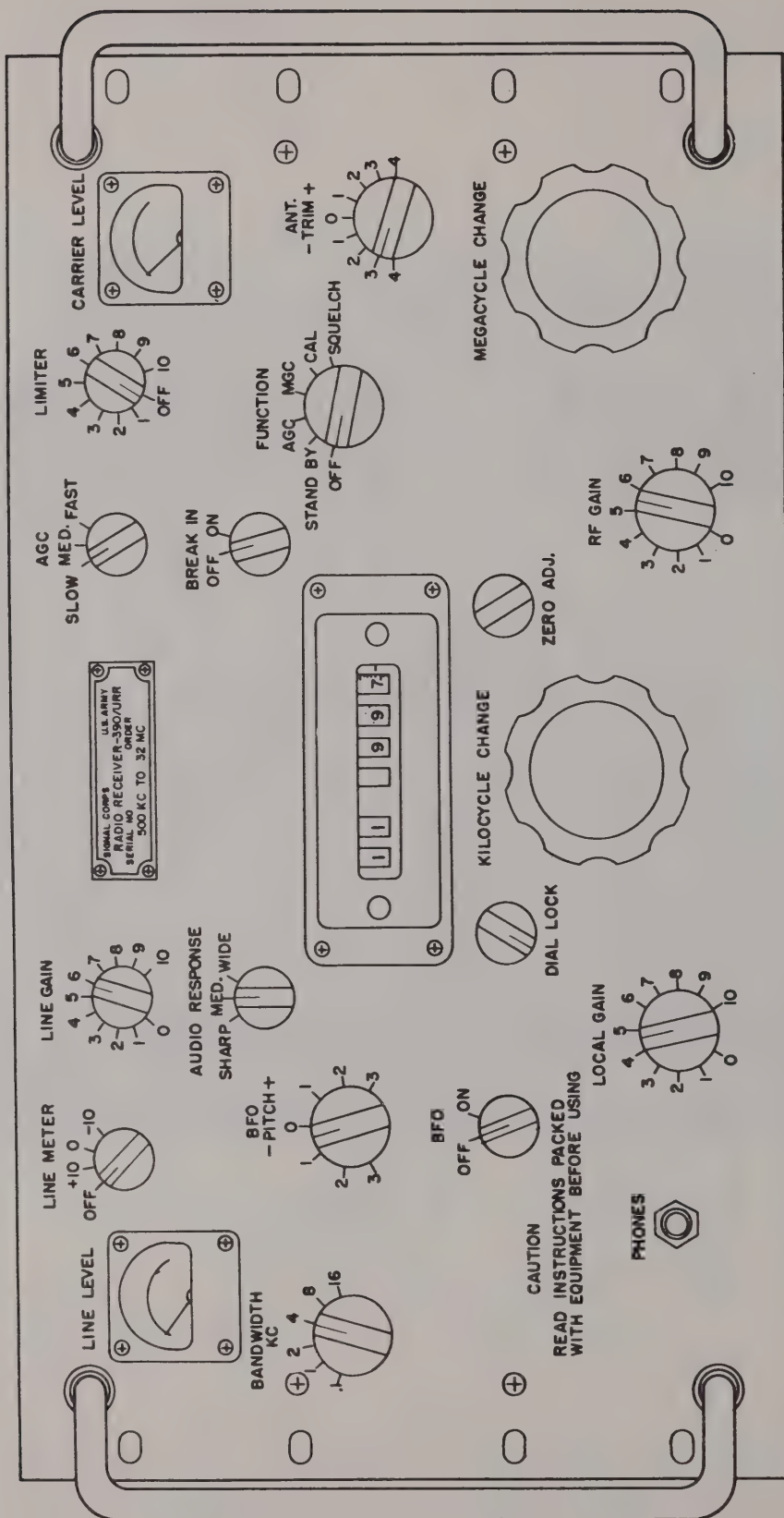
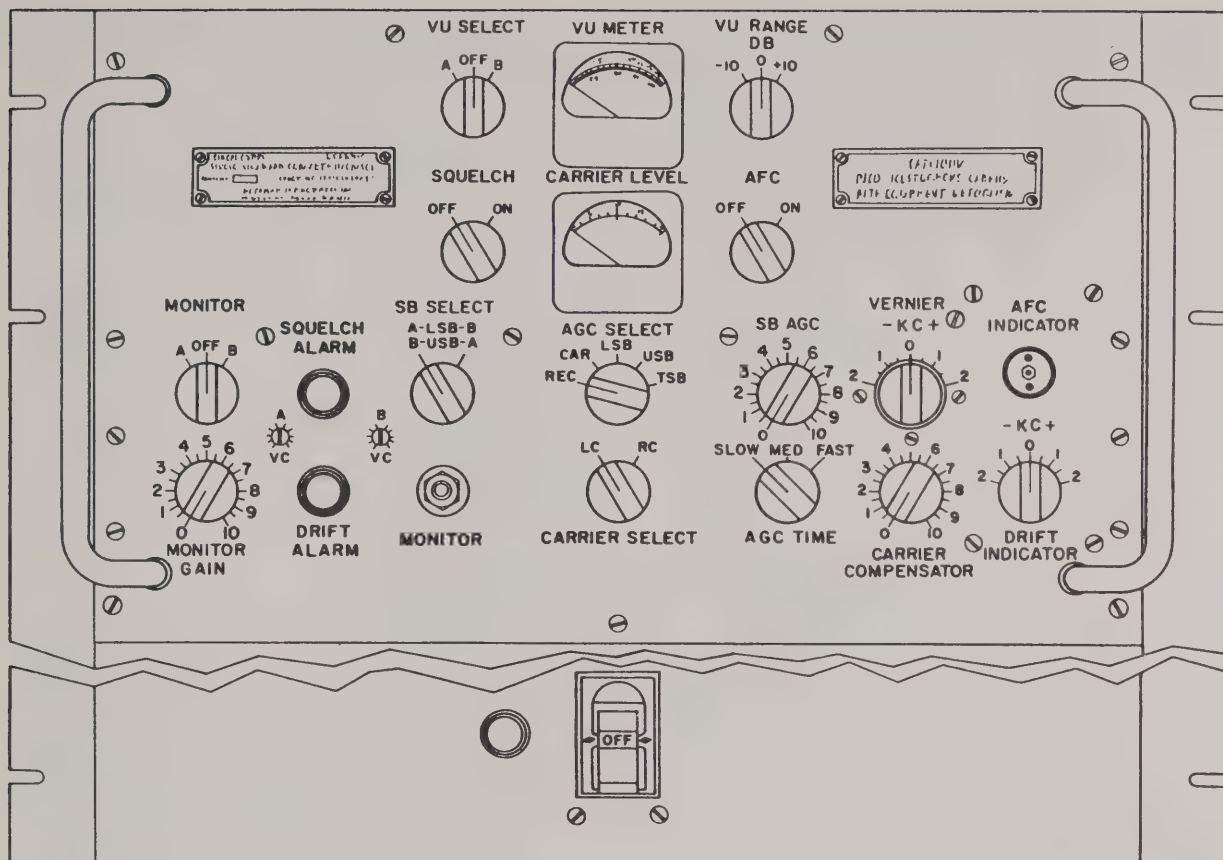


Figure 12. Single Sideband Converter CV-167/URR (rear view), dust cover removed.



TM 856-19

Figure 13. Radio Receiver R-390/URR, front panel.



TM 266-8

Figure 14. Single Sideband Converter CV-157/URR, front panel.

Section II. EQUIPMENT INSTALLATION

17. Installation of Radio Receiving Set AN/FRR-40

a. Set Electrical Equipment Cabinet CY-1119/U on a level section of floor area that will permit the rear of the equipment to be reached easily (par. 14b). Insert two fuses, F1101 and F1102, provided in the installation kit (fig. 15) into the fuse sockets (fig. 19). Do not screw them in so tightly that removing a blown fuse will be difficult. Refer to paragraph 16a for 230-volt operation.

b. The interior of the cabinet is provided with mounting holes to which the angle support brackets, A 1101 through A 1104 (fig. 15), may be attached. These holes are arranged in four vertical rows, one row at each corner of the cabinet. To properly install the brackets, follow the instructions below:

- (1) Count 21 mounting holes down from the top of the cabinet in each row. Mount an

angle bracket across *each side* of the cabinet at the 21st hole (fig. 31). Fasten the brackets at the front and rear with the bracket mounting hardware H1102, H1106, H1107, and H1105 (fig. 15), provided in the installation kit.

- (2) Mount the brackets and tighten them so that they can be moved up or down when tapped with a soft-headed mallet.
- (3) Mount the next set of brackets in the 41st hole down from the top on each side.

c. Using figure 1 as a guide, fasten the 12 $\frac{1}{4}$ -inch high top blank panel, A 1108 (fig. 15), securely in place. Use eight each of the 60 ovalhead screws and cup washers that are provided with the cabinet. These screws and washers are part of the miscellaneous hardware found in a small cloth bag that is attached to the cabinet (fig. 4).

d. To install Radio Receiver R-390/URR, proceed as follows:

- (1) Position the receiver in the cabinet immediately below the blank panel. Fasten it in place with eight each of the screws and washers provided with the cabinet.
- (2) The angle brackets should be flush against the receiver base assembly so that the weight is evenly supported. Tap the brackets into position with the mallet.
- (3) Remove the eight screws and washers that hold the receiver to the cabinet.
- (4) Remove the receiver from the cabinet and securely tighten the bolts that hold the angle brackets.
- (5) Before replacing the receiver, be sure that all tubes and crystal holders are firmly seated in their proper sockets. Be sure that the proper fuses are inserted in the fuse holders located on the rear of the receiver (fig. 31).
- (6) Replace the receiver in the cabinet and fasten it securely in place with eight each of the screws and washers provided.

e. Using figure 1 as a guide, fasten the 1 $\frac{3}{4}$ -inch high blank panel, A 1105 (fig. 15), directly below the receiver. Use four each of the ovalhead screws and cup washers that are provided with the cabinet.

f. Position the converter immediately below the 1 $\frac{3}{4}$ -inch high blank panel, and fasten it securely with eight each of the ovalhead screws and cup washers provided.

Caution: Two or three men should help position the converter because of its weight.

- (1) The angle brackets should be flush against the converter so that the weight is evenly supported. Tap the brackets into position with the soft-headed mallet.
- (2) Remove the eight ovalhead screws and washers.
- (3) Remove the converter and tighten securely the bolts that hold the angle brackets.
- (4) Before replacing the converter, check the crystal holder and all tubes; be sure that they are firmly seated in their proper sockets. The tubes are accessible when the drawer assembly is extended by loosening the seven unpainted captive fillister-head locking screws on the front panel, and pulling the assembly forward. These un-

painted screws are cadmium-plated. *Do not remove the screws that have been painted.* These screws hold components in place within the equipment. Check the power supply tubes, as well as those mounted directly on the drawer.

- (5) Replace the converter in the cabinet and fasten it securely in place.

g. Using figure 1 as a guide, fasten two 12 $\frac{1}{4}$ -inch high blank panels, A 1106 and A 1107 (fig. 16), securely in place directly below the converter. Use eight each of the ovalhead screws and cup washers provided with the cabinet for *each* panel.

h. Using figure 1 as a guide, fasten a 5 $\frac{1}{4}$ -inch high blank panel, A 1109 (fig. 15), securely in place directly below the two 12 $\frac{1}{4}$ -inch high blank panels. Use four each of the ovalhead screws and washers provided with the cabinet.

Note. Additional equipment may be mounted in the cabinet instead of the blank panels mentioned. If additional equipment is used, be sure that adequate fuses and wiring are provided.

i. Fasten the name plate that is provided in the installation kit, N1101 (fig. 15), to the top front of the cabinet. Use four of the eight small slotted bindinghead machine screws, H1101, that are provided in the installation kit.

j. Fasten the caution plate, N1102 (fig. 15), securely to the top of the rear door of the cabinet with the remaining four slotted bindinghead machine screws.

18. Installation of Radio Receiving Set AN/FRR-41

a. Follow the instructions given in paragraph 16a, but use fuses F1201 and F1202 (fig. 16) instead of fuses F1101 and F1102.

b. To mount the component support brackets for the AN/FRR-41 in the cabinet, refer to figure 16 and proceed as follows:

- (1) Count 11 mounting holes down from the top of the cabinet in each row. Mount an angle bracket across *each* side of the cabinet along the 11th hole. Fasten the brackets at the front and rear with the bracket mounting hardware H1202, H1205, H1206, and H1207 provided in the installation kit.
- (2) Mount the brackets and tighten so that they can be moved up or down when tapped lightly with the mallet.

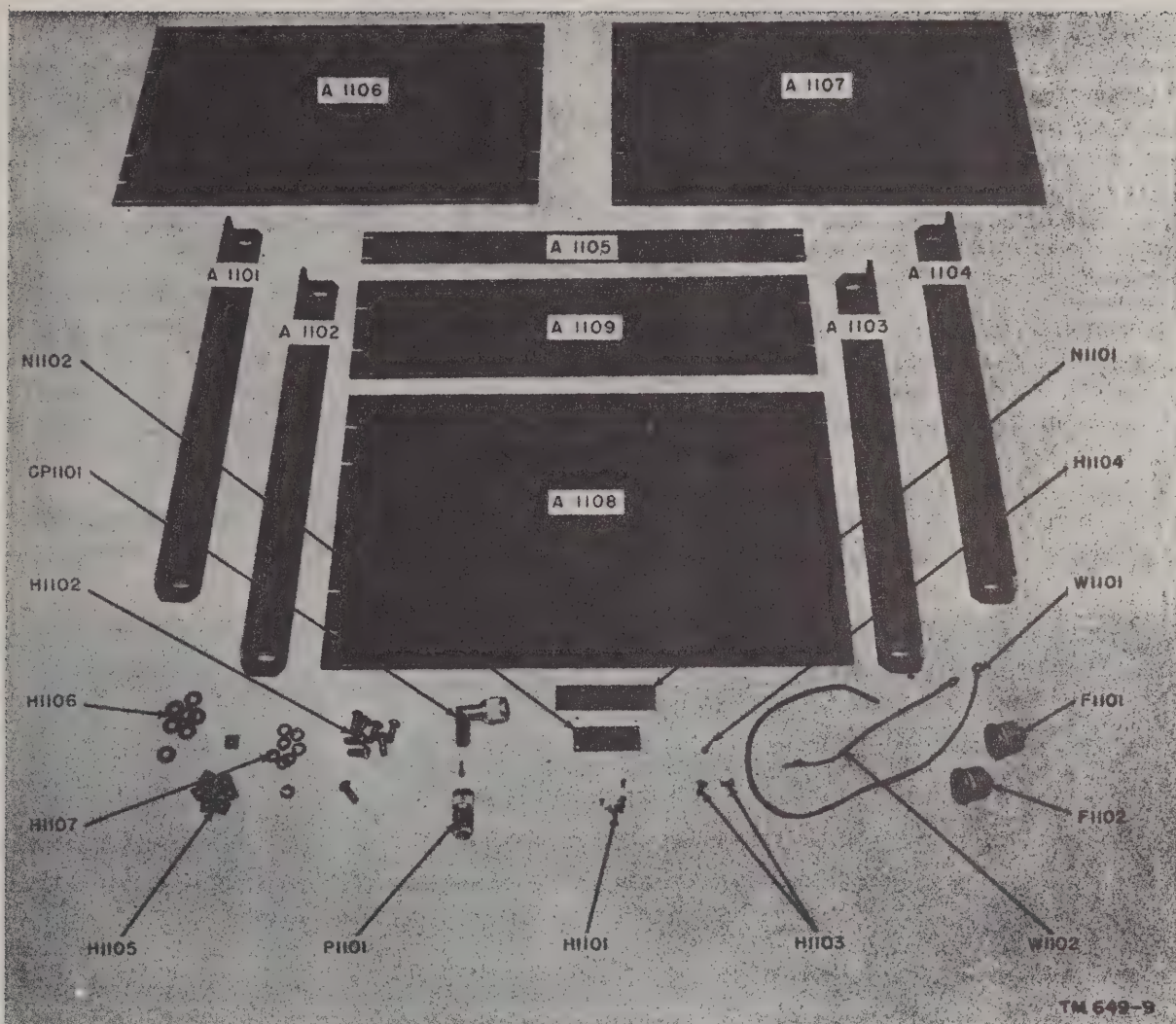


Figure 15. Installation kit for Radio Receiving Set AN/FRR-40.

- (3) Mount the next set of brackets in the 31st hole down from the top of each side.
- (4) Mount the next set of brackets in the 45th hole down from the top of each side.
- (5) Mount the last set of brackets in the 65th hole down from the top of each side.

c. Using figure 1 as a guide, fasten the 3½-inch high top blank panel, A 1212, securely in place. Use four each of the ovalhead screws and cup washers that are provided with the cabinet. These screws and washers are part of the miscellaneous hardware found in a small cloth bag that is attached to the cabinet (fig. 5).

d. Install the first receiver (par. 17d).

e. Using figure 1 as a guide, fasten a 1¾-inch high blank panel, A 1211, securely in place directly below the receiver. Use four each of the ovalhead screws and cup washers provided with the cabinet.

f. Install the first converter (par. 17f).

g. Using figure 1 as a guide, fasten a 1¾-inch high blank panel, A 1210, securely in place directly below the converter. Use four each of the ovalhead screws and cup washers provided with the cabinet.

h. Install the second receiver.

i. Install the 1¾-inch high blank panel, A 1209.

j. Install the second converter.

k. Using figure 1 as a guide, fasten the 3½-inch high blank panel, A 1214, securely in place directly

below the converter. Use four each of the ovalhead screws and washers that are provided with the cabinet.

l. Using figure 1 as a guide, fasten the 5¼-inch high blank panel, A 1213, directly below the 3½-inch high panel with four each of the ovalhead screws and washers provided with the cabinet.

Note. Additional equipment may be mounted in the cabinet instead of the blank panels mentioned. If additional equipment is used, be sure that adequate fuses and wiring are provided.

m. Fasten the nameplate, N1201, provided in the installation kit to the top front of the cabinet. Use four of the 8 small slotted bindinghead machine screws, H1201, which are provided in the installation kit.

n. Fasten the caution plate, N1202, securely to the top of the rear door of the cabinet. Use the remaining four slotted bindinghead machine screws.

19. Connections

(figs. 17, 18, 19, and 20)

When making the connections between components of the AN/FRR-40 and AN/FRR-41, dress the connecting cables behind the angle brackets to provide as neat an arrangement as possible (fig. 31).

a. Connections for Radio Receiving Set AN/FRR-40.

- (1) Connect Power Cord CD-370 between the PWR IN jack of the converter and the power receptacle strip of the cabinet.
- (2) Connect Power Cable Assembly CX-1358/U between POWER J104 receptacle of the receiver and the power receptacle strip of the cabinet.
- (3) Connect Cord CG-409E/U between J1 IF INPUT receptacle of the converter and

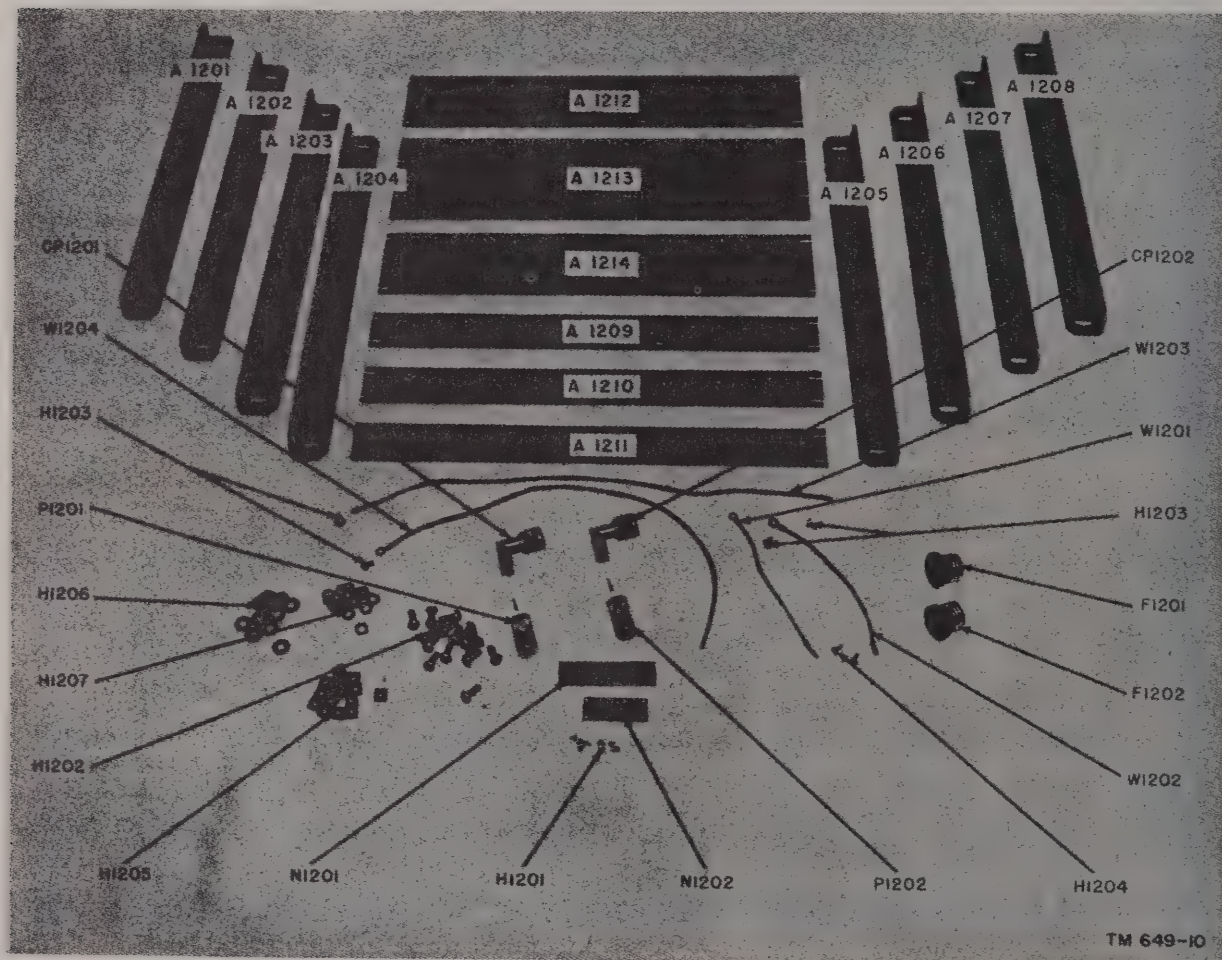


Figure 16. Installation kit for Radio Receiving Set AN/FRR-41.

J106 IF OUTPUT 50-OHM receptacle of the receiver.

- (4) Remove the jumper between terminals 3 and 4 of TB102 of the receiver, and connect age Cord CD-135 from terminals 3, 4, and 7 of the receiver to terminals 7, 8, and 9 on TB2 of the converter.
- (5) Assemble Plug Connector UG-573/U, P1101 (fig. 15), to the antenna lead-in transmission cable.
- (6) Connect each Plug Connector UG-573/U to an Adapter Connector UG-971/U, CP1101 (fig. 15).
- (7) Connect the antenna lead-in to J108 BALANCED 125 OHM receptacle of the receiver.
- (8) Connect the ground strap, W1102 (fig. 15), from the cabinet ground strip to the receiver. One end is fastened with one of the 10-32 slotted bindinghead screws, H1103 (fig. 15), to the cabinet ground strip. Fasten the other end of the ground strap to the receiver with 6-32 slotted bindinghead screw, H1104 (fig. 15).
- (9) Connect the ground strap, W1101 (fig. 15), from the cabinet ground strip to the converter with one of the 10-32 slottedhead screws to fasten one end at the cabinet ground strip. Connect the other end of the ground strap to the GND post at the rear of the converter.

b. Power Input to AN/FRR-40. Connect the cable from the power source to the switch box within the cabinet as follows:

- (1) Use the access opening most suitable (fig. 4) to bring in the power cable. Take off the cover plate by removing the four bolts that hold it in place.
- (2) The switch box within the cabinet is provided with knockout panels which may be removed to provide power cable entry to the box. Determine which panel is to be used, and remove it by placing the point of a punch in the center of the panel and tapping the punch with a hammer.
- (3) Solder a spade-type lug to the end of each conductor of the power cable.
- (4) Connect the cable leads to the switch box line terminals. Tighten the screws firmly on the lugs to insure good electrical contact.

Caution: Electrical Equipment Cabinet CY-1119/U should be securely grounded before power is applied, to prevent possible injury to personnel.

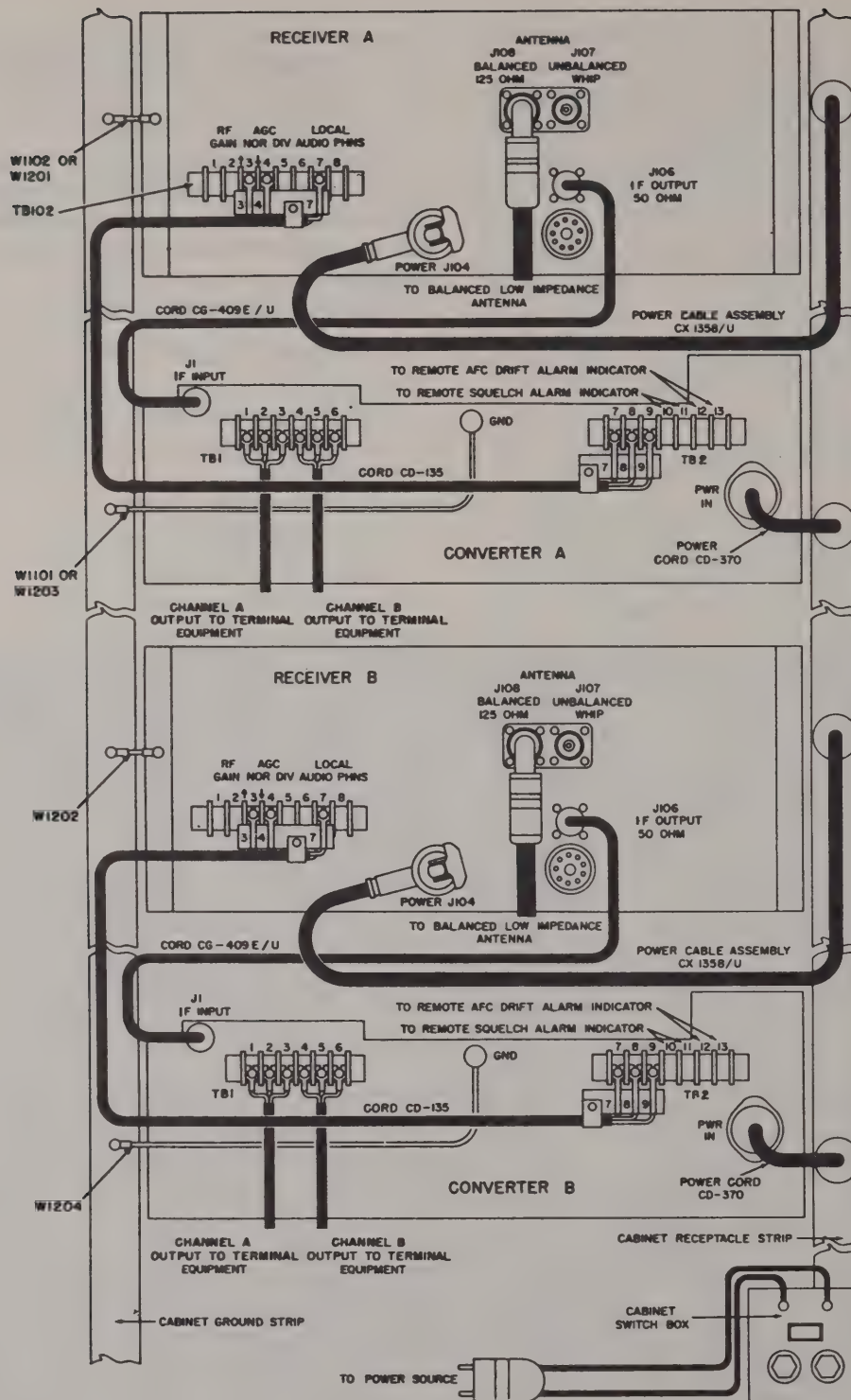
c. Connections for Radio Receiving Set AN/FRR-41. Refer to figure 17, and follow the instructions in *a* above for making the connections on the AN/FRR-41 except for the following changes:

- (1) Use ground straps W1201 and W1202 in place of ground strap W1102 (fig. 16 and 15).
- (2) Use ground straps W1203 and W1204 in place of ground strap W1101 (fig. 16 and 15).
- (3) Use screws H1204 in place of screws H1104 (fig. 16 and 15).
- (4) Use screws H1203 in place of screws H1103 (fig. 16 and 15).

d. Power Input to AN/FRR-41. Follow the procedures outlined in *b* above.

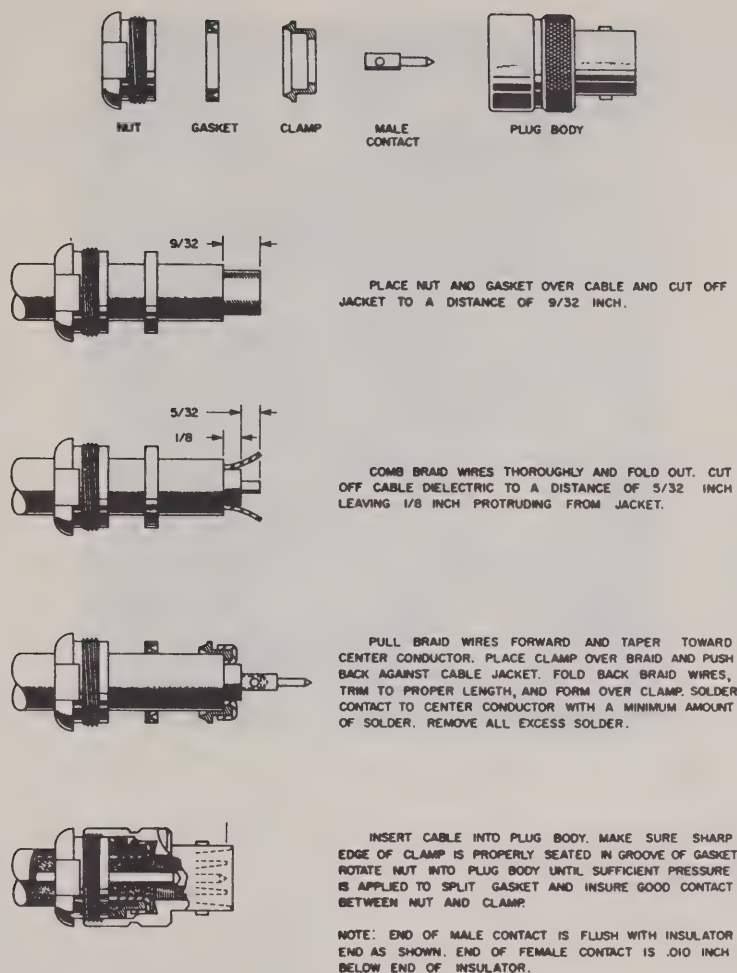
e. Connections for Cable Assemblies not Supplied. Cables for the audio outputs and the remote alarm facilities of the converter are not included with the equipments that are delivered. To make these connections, it will be necessary to fabricate cable assemblies. Instructions for the connections to be made and for the fabrication of the cables are given in (1) through (3) below.

- (1) *Converter audio output channels.* Make up two audio output cables for the AN/FRR-40. Make up four cables for the AN/FRR-41. Use a two-conductor shielded cable for each output channel desired, such as WD-30/U or any similar type. Unbraid a section of the shield and solder a spade lug to it. Solder a spade lug to each of the two conductors. For channel A, connect the conductors to terminals 1 and 3 of terminal board TB1 on the converter, and connect the shield to terminal 2, which is chassis ground. For channel B, connect the two conductors to terminals 4 and 6 of TB1, and connect the shield to terminal 5 (ground) of TB1. For connections at the terminal equipment end of the cable, refer to the appropriate manual.
- (2) *Remote alarm connections.* Terminals 10 and 11 of converter terminal board TB2



TM 649-12

Figure 17. Radio Receiving Set AN/FRR-40 and AN/FRR-41, cording diagram.



TM 647-14

Figure 18. Assembly instructions for Plug Connector UG-573/U.

provide a 6.3-volt ac 250-milliampere (ma) maximum output to operate a remote squelch alarm indicator; terminals 12 and 13 provide a 6.3-volt ac, 250 ma maximum output for a remote automatic frequency control (afc) drift alarm indicator. Remote alarm indicators are a necessity for operating personnel when the converter is located at some point far from the communication center where messages are actually being received. Figure 20 shows suggested circuits for both visual and audible remote alarm systems. The connection to the alarm indicator should be made with a twisted pair of telephone wires or a two-conductor unshielded cable, such as WD-29/U or any similar type. Solder spade lugs to the two conductors

and connect them to the terminals of TB2. Connections to the alarm indicator will be used as required by the type of indicator used.

Note. The audible indicator is shown connected through a relay. This connection is necessary when the bell or buzzer operates from a power source other than the 6.3-volt ac available from the converter, or when the audible indicator requires more than .25 ampere for its operation. An audible indicator, operative from 6.3-volt ac and drawing less than .25 ampere, may be connected directly to the remote alarm output without an isolating relay.

- (3) *Voice order wire.* In some installations, one sideband may be used as a voice order wire. Select either channel A or B output to deliver the voice intelligence to the audio reproducing equipment (loudspeaker,

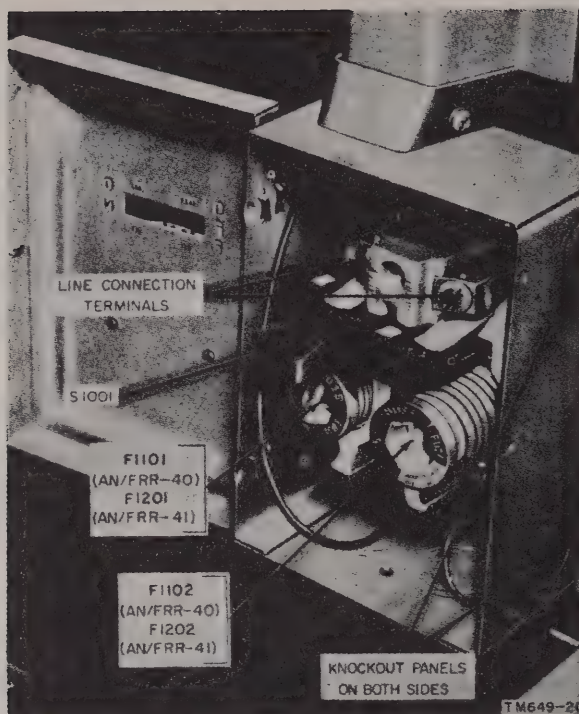


Figure 19. Switch box in Electrical Equipment Cabinet CY-1119/U.

headset, telephone, etc.). For connections to the converter, follow the instructions in (1) above. Make the connections to the audio reproducing equipment as required.

20. Selecting Antenna

Radio Receiver R-390/URR has sufficient sensitivity and selectivity to operate satisfactorily under most conditions with a simple long-wire or whip antenna. For more dependable operation over great distances, however, it is desirable to use more efficient antennas in permanent or semipermanent types of installations.

a. Double-douplet Antenna (fig. 21). The double-douplet antenna may be regarded as a general-purpose broad band antenna that is suitable for reception of transmitted signals from any direction except off the ends. Detailed installation instructions for a double-douplet antenna are given in TM 11-2629.

b. Horizontal Rhombic Antenna (fig. 22). The type of receiving antenna most commonly used for operation over great distances between permanent installations is the horizontal rhombic. This type of antenna has very good broad band charac-

teristics and is much more directional than the double-douplet type described in *a* above. Detailed instructions for the erection and dimensioning of receiving horizontal rhombic antennas for various operating distances are given in TM 11-2611.

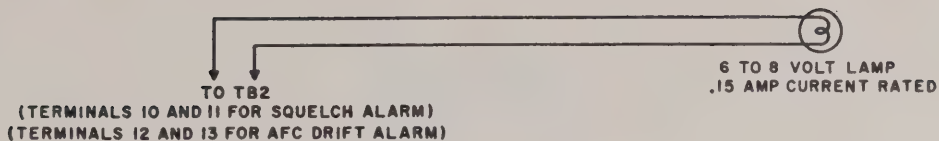
21. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions outlined in paragraph 15 for uncrating, unpacking, and checking the equipment.

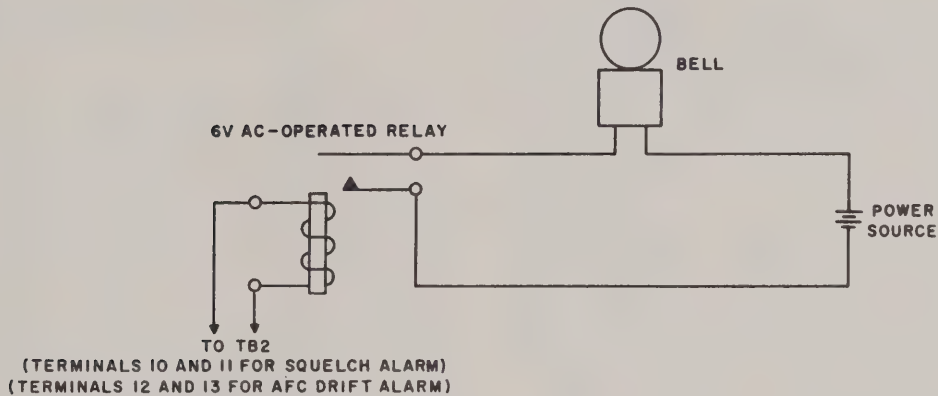
b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the changes in this manual and in the component manual of the specific unit, preferably on the schematic diagram.

c. Check the operating controls for ease and smoothness of rotation. If lubrication is required, refer to paragraphs 42 and 43 for instructions.

d. Perform the preinstallation, installation, and connection procedures given in paragraphs 16 through 19.



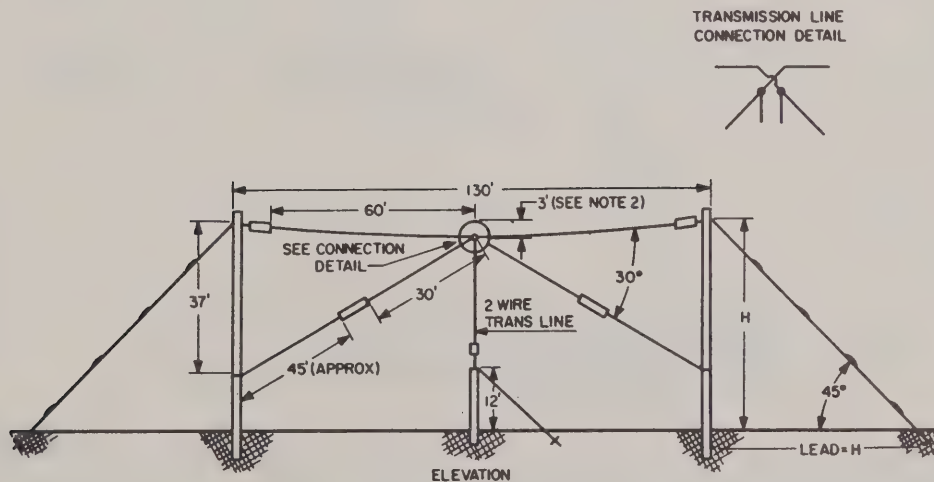
A. SUGGESTED VISUAL METHOD



B. SUGGESTED AUDIBLE METHOD

TM 266-7

Figure 20. Visual and audible methods for remote squelch and afc drift alarm indicators.

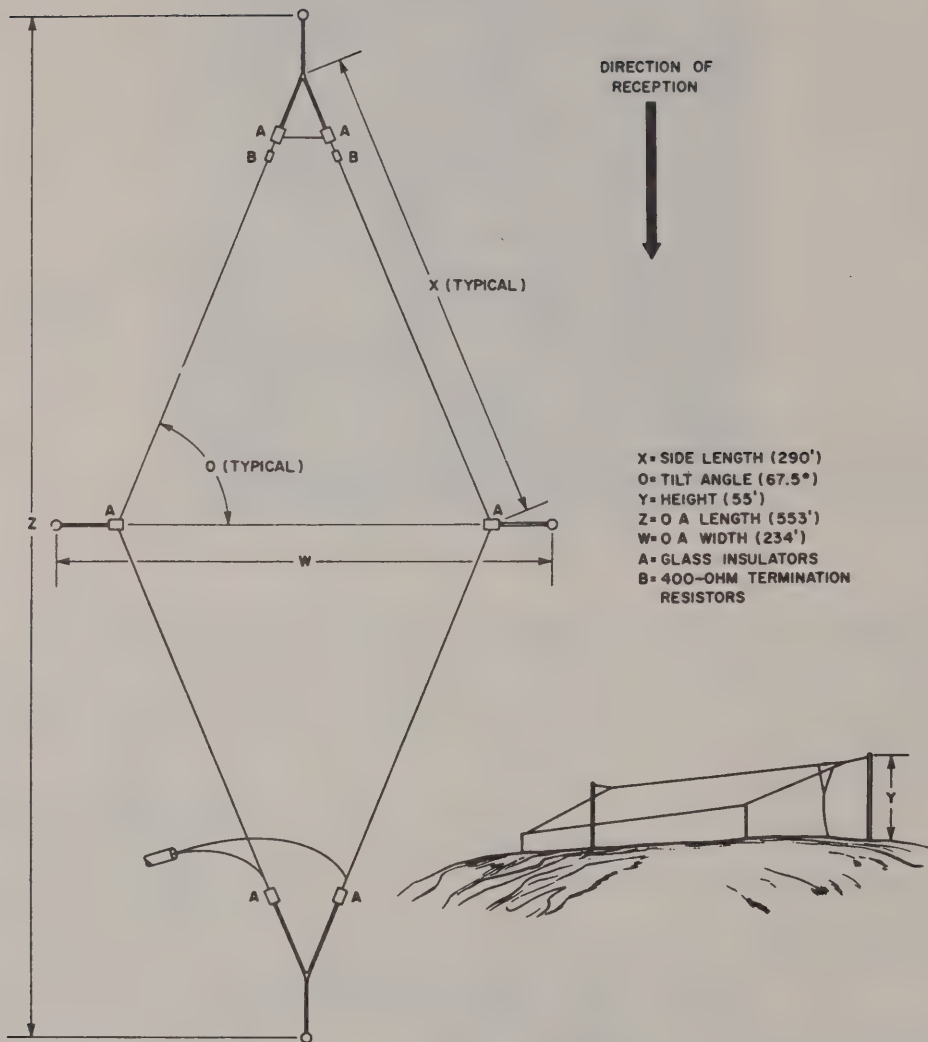


NOTES:

1. BAND RANGE 2.5-20 MC.
2. INITIAL DEFLECTION, DOWN LEAD & LOWER ELEMENTS HANGING FREE.
3. H SHOULD BE AS HIGH AS PRACTICABLE.

TM 647-16

Figure 21. Double-doublet antenna for use between 2.5 and 20 mc.



NOTES:

1. FEED EACH CONDUCTOR OF BALANCED LINE FROM ONE SIDE OF ANTENNA.
2. TERMINATION RESISTORS SHOULD BE NON-REACTIVE.
3. SINGLE TERMINATION RESISTOR (800-OHM) IS SATISFACTORY.
4. WITHOUT TERMINATION RESISTORS, ANTENNA WILL BE BI DIRECTIONAL ALONG ITS LONGEST DIMENSION.

TM 647-17

Figure 22. Horizontal rhombic antenna suitable for use over distances of 1,000 to 1,500 miles.

CHAPTER 3

OPERATION

Section I. OPERATION UNDER USUAL CONDITIONS

22. Controls and Instruments

(figs. 13 and 14)

a. General. In AN/FRR-40 and AN/FRR-41, performance can only be achieved by careful setting of the various controls and interpretation of the instruments throughout the operating procedure. A thorough understanding of the interrelationship of the controls and instruments is important in optimum performance. Refer to the component manuals for the description of all of the controls and instruments before attempting operation. The combinations of control settings are numerous. Because of changing signal conditions in the atmosphere, only operating experience will enable the operator to become familiar with the change of control settings

with the change of conditions of the signals. As an aid to the operator, the data given below will describe the controls and instruments that are related to each other in operation of Radio Receiving Sets AN/FRR-40 and AN/FRR-41.

b. Relationship Between SB SELECT and MONITOR Switches. The SB SELECT switch may be difficult to read correctly; therefore, refer to figure 23 for an understanding of the two positions of the switch. When the switch is in the right hand (counterclockwise) position, it reads A-LSB, B-USB, and when the switch is in the left hand (clockwise) position, it reads LSB-B, USB-A. In the table below, the keyed signals will be referred to as *tones* and the voice frequencies will be referred to as *voice*.

Types of signals	Modulation in sideband	Switch		Output	
		SB SELECT	MONITOR	Channel A	Channel B
Twin single sideband	Tones in upper sideband and voice in lower sideband.	LSB-B	A	Tones	
		USB-A	B		Voice
		A-LSB	A	Voice	
		B-USB	B		Tones
	Voice in upper sideband and tones in lower sideband.	LSB-B	A	Voice	
		USB-A	B		Tones
		A-LSB	A	Tones	
		B-USB	B		Voice
Single sideband	Tones in upper sideband.	LSB-B	A	Tones	
		USB-A	B		
		A-LSB	A		
		B-USB	B		Tones

Types of signals	Modulation in sideband	Switch		Output	
		SB SELECT	MONITOR	Channel A	Channel B
Single sideband—cont.	Voice in upper sideband.	LSB-B	A	Voice	
		USB-A	B		
		A-LSB	A		
		B-USB	B		Voice
	Tones in lower sideband.	LSB-B	A		
		USB-A	B		Tones
		A-LSB	A	Tones	
		B-USB	B		
	Voice in lower sideband.	LSB-B	A		
		USB-A	B		Voice
		A-LSB	A	Voice	
		B-USB	B		

c. Relationship Between AGC SELECT and AGC TIME Switches. The table below shows the relationship of the AGC SELECT and AGC TIME

switches set under normal receiving conditions. For a setting of the switches under signal interference conditions, refer to paragraph 32b.

Types of signals	Modulation in sideband	Switch	
		AGC SELECT	AGC TIME
Twin single sideband	Tones and voice	LSB or USB*	FAST
	Tones	TSB	FAST
	Voice	CAR	MED
Single sideband	Tones	LSB or USB*	FAST
	Voice	CAR	MED
Double sideband (am)	Voice	CAR	MED

* Depends on which sideband contains the keyed-tones; refer to table paragraph 22b.

d. SQUELCH ALARM Indicator. Infrequent flashes of the SQUELCH ALARM indicator (white lamp) during the course of operation are normal. Refer to paragraph 33 if the lamp remains lighted.

e. DRIFT ALARM Indicator. The DRIFT ALARM indicator (red lamp) remains unlighted during operation. If it lights up, refer to paragraph 34 for readjustment of the DRIFT INDICATOR.

23. Preliminary Starting Procedure

a. Receiver.

- (1) Check the voltage of the ac power source and set the receiver for this value (par. 16a).
- (2) Check OVENS switch for ON or OFF position as required (par. 16b).

b. Converter.

- (1) Set the converter for correct ac power input as checked in *a*(1) above. Refer to paragraph 16a for proper setting.
- (2) Check the LOW PASS FILTER switch for correct position (par. 16e).

c. Cabinet.

- (1) Check the fuses for correct size to match ac power source (par. 16a).
- (2) Throw power switch, S1001 (fig. 19), to ON.

24. Starting Procedure

a. Radio Receiver R-390/URR (fig. 13). Place the front panel controls as follows:

Control	Position
BFO switch	OFF
BANDWIDTH switch	16 KC
FUNCTION switch	MGC
AGC switch	SLOW
LOCAL GAIN control.....	5
LIMITER control	OFF
RF GAIN control.....	5
ANT. TRIM control.....	0

b. Single Sideband Converter CV-157/URR (fig. 14). Place the panel controls as follows:

Control	Tones	
	Upper sideband position	Lower sideband position
MONITOR switch.....	A	B
MONITOR GAIN control.....	5	5
A-VC control.....	See par. 16d	See par. 16d
B-VC control.....	See par. 16d	See par. 16d
SB SELECT switch.....	LSB-B, USB-A	LSB-B, USB-A
VU SELECT switch.....	A	B
VU RANGE switch.....	+10 DB	+10 DB
SQUELCH switch.....	OFF	OFF
AFC switch.....	OFF	OFF
AGC SELECT switch.....	REC	REC
CARRIER SELECT switch.....	LC	LC
SB AGC control.....	7.5	7.5
AGC TIME switch.....	SLOW	SLOW
VERNIER* control.....	0 KC	0 KC
CARRIER COMPENSATOR control.....	6.5 (20-db point)	6.5 (20-db point)
DRIFT INDICATOR control.....	0 KC	0 KC
Power switch.....	ON	ON

* Since the drive to the VERNIER is geared down, an outer disk showing the change in position of the capacitor rotor is provided on the VERNIER control. The short line on this outer disk must be lined up opposite the "0" marked on the front panel.

25. Sideband Containing Keyed-tones Recognition

The method of determining which sideband the keyed-tones are placed is as follows:

a. Keyed-tone Recognition Using Radio Receiver R-390/URR.

- (1) Plug a headset into the PHONES jack on the receiver.
- (2) Tune in a single-sideband or a twin single-sideband signal.
- (3) Turn the RF GAIN control up to the overload point of the receiver.

- (4) Adjust ANT. TRIM control for a maximum reading on the CARRIER LEVEL meter.
- (5) Adjust the LOCAL GAIN control for a comfortable signal level.
- (6) Vary the KILOCYCLE CHANGE control dial higher in frequency until the intelligence is barely audible. Note the dial reading.
- (7) Vary the dial lower in frequency until the intelligence is barely audible. Note the dial reading.
- (8) The sideband that contains the keyed-tone intelligence is the one that gives the greater difference. If the greater displacement is higher than the carrier frequency, the teletypewriter signals are in the upper sideband. If the greater displacement is lower than the carrier frequency, the teletypewriter signals are in the lower sideband.
- (9) Reset the following controls before starting operation:
 - (a) FUNCTION switch to AGC.
 - (b) RF GAIN control to 10.

Note. If the receiver dial does not indicate the *exact* frequency known to be the transmitted carrier frequency, the deviation may be attributed to the total system drift (transmitter, receiver, and converter). As each piece of equipment in the system drifts, the total drift will therefore be the sum of the drifts of individual equipments in the system.

b. Keyed-tone Recognition Using Receiver and Converter. The purpose of this tuning is to locate the sideband that contains the keyed tones. The MONITOR and SB SELECT switches may be set in any position to start this procedure.

- (1) Follow the procedures outlined in a(1) through (4) above.
- (2) Set the converter controls as shown in the *upper sideband position* column of the table given in paragraph 24b.
- (3) Plug the headset into the MONITOR jack of the converter.
- (4) Turn the KILOCYCLE CHANGE control of the receiver above and below the assigned carrier frequency.
- (5) The tones will be recognized as follows:
 - (a) If tones are heard only on one side of the center of the carrier, turn the MONITOR switch to the opposite position. The sideband that contains the keyed tones as sent by the transmitting station will be recognized by looking at the SB SELECT switch position corresponding to the MONITOR switch setting.
 - (b) If tones are heard on both sides of the center of the carrier, do not change the MONITOR switch position. The sideband that contains the keyed tones as sent by the transmitting station will be recognized by looking at the SB SELECT switch position corresponding to the MONITOR switch setting.
- (6) The following example is given to help the operator to determine which sideband contains the keyed tones:
 - (a) Set the SB SELECT switch to the A-LSB, B-USB position.
 - (b) Set the MONITOR switch to the A position.
 - (c) Tune the receiver to the assigned carrier frequency.
 - (d) Turn the KILOCYCLE CHANGE control of the receiver above and below the center frequency of the carrier while listening to the tones in the converter headset.
 - (e) If the tones are heard only on one side of the carrier when the procedure outlined in (d) above was carried out, then leave the MONITOR switch in the A position to start the operational steps given in paragraph 26. If the tones were heard on both sides of the carrier, then place the MONITOR switch in the B position and operation is ready to begin.
 - (f) If the MONITOR switch is left at A, then the tones as transmitted are contained in the upper sideband of the carrier. If the switch is turned to B, then the tones are contained in the lower sideband of the carrier.
 - (g) If the SB SELECT switch had been set to the LSB-B, USB-A position and the MONITOR switch at the B position in (a) and (b) above, then the tones should have been heard on both sides when the MONITOR switch was in the A position and heard only on one side when in the

B setting. For operational tuning procedure, leave the MONITOR switch at B and for monitoring purposes of tuned-in signals, place the switch at A. Note that in either setting of the SB SELECT or the MONITOR switch positions of the above procedure, the tones are contained in the transmitted upper sideband.

26. Operation of Radio Receiving Set AN/FRR-40

a. Operation for Reception of Twin Single-sideband Signals, 20-db Reduced Carrier.

(1) *One sideband containing keyed-tone intelligence, one sideband containing voice intelligence, and/or facsimile.*

- (a) Determine which sideband contains the keyed-tone intelligence (par. 25) if instructions give only operating frequency.
- (b) Retune the receiver to the operating frequency.
- (c) Set the MONITOR switch to the *opposite* position of the Sideband containing the tones.
- (d) Plug a headset into the MONITOR jack and adjust the MONITOR GAIN control for a comfortable audible level.
- (e) Turn the short line on the outer disk of the VERNIER control to the +1 KC position if the MONITOR switch is in the B position. Turn the VERNIER control to set the line on the outer disk at the -1 KC position if the MONITOR switch is in the A position.
- (f) Listen at the headset. If the receiver has been properly tuned, a large number of tones will be audible in the monitored channel.
- (g) Carefully tune the VERNIER control toward its 0 position (the disk cursor lined up opposite the 0 on the front panel). The frequency of the keyed tones that are audible in the monitored channel will each, in turn, pass through a zero beat. The last tone in the monitored channel is the carrier frequency. As the carrier frequency approaches a zero beat (no signal will be heard in the headset), the CARRIER LEVEL meter

of the converter will indicate a sharp deflection to the right. The VERNIER control setting should not be changed now.

Note. In one type of a system transmitting teletypewriter signals, the first tone (mark) is 425 cps from the carrier and the second tone (space) is 595 cps from the carrier. These tones represent the first message. The next message uses two more tones. The mark tone is 170 cps higher than the space tone of the first message, and the space tone is an additional 170 cps higher. The remainder of the messages have the same frequency progression. Another system uses 85-cps spacing of the message tones. The first message starts 425 cps from the carrier. In 1 revolution, the VERNIER control knob covers 200 cps. In 2 revolutions, it covers 400 cps, etc.

- (h) Turn the AFC switch of the converter to the ON position. The AFC INDICATOR of the converter should turn slightly, indicating proper operation of the afc circuit.
 - (i) Turn SQUELCH switch of the converter to ON. Leave it in this position for normal operation of the converter.
 - (j) Set the AGC SELECT switch of the converter to the position corresponding to the tones contained in the sideband.
 - (k) Set the AGC TIME switch of the converter to the FAST position.
 - (l) Set the MONITOR switch to the appropriate channel. When not monitoring, turn the switch to OFF.
- (2) *Alternate method of tuning.*
- (a) Set the receiver and converter controls as in the starting procedure (par. 24).
 - (b) Perform the procedures outlined in (1)(a) through (d) above.
 - (c) Readjust the receiver dial until most of the transmitted teletypewriter intelligence is audible in the undesired channel of the converter.
 - (d) Slowly tune the receiver dial back towards the known carrier frequency.
 - (e) As the carrier frequency is approached, each tone in turn will pass through a zero beat and the CARRIER LEVEL meter of the converter will deflect to the right.
 - (f) As the last tone (transmitted carrier) approaches zero beat, observe the CAR-

RIER LEVEL meter. It deflects *sharply* to the right and no signal will be heard in the headset (zero beat).

Note. Difficulty may be experienced in turning the receiver tuning dial slowly enough to place the carrier signal in the carrier channel. In this case, use the receiver tuning dial to get as close to the zero beat point as possible. Leave the receiver in this position and adjust the VERNIER control on the converter to tune the carrier signal in.

- (g) Turn the AFC switch to ON.
- (h) Return the controls to the positions indicated in (1) (i) through (l) above.
- (3) *Operation for reception of twin single-sideband with teletypewriter signals on both sidebands.*
 - (a) Set the receiver and converter controls as described in paragraph 24.
 - (b) Tune the receiver to the operating frequency.
 - (c) Plug in a headset at the MONITOR jack and adjust the MONITOR GAIN control of the converter for a comfortable audible level.
 - (d) Rotate the VERNIER control until a signal carrier is tuned in as indicated by the CARRIER LEVEL meter deflecting to the right.
 - (e) Note the positions of the VERNIER control and the AFC INDICATOR.
 - (f) Rotate the VERNIER control in a *clockwise* direction until the CARRIER LEVEL meter again deflects to the right. Note the number of revolutions of the VERNIER control with respect to its initial position ((e) above). Return the control to its original position of (e) above.
 - (g) Rotate the VERNIER control in a *counterclockwise* direction until the CARRIER LEVEL meter deflects to the right. Note the number of revolutions of the control with respect to its position ((e) above). If there is a difference of more than 2 revolutions from the original position in both the clockwise and counterclockwise directions, the position in (e) above represents the carrier frequency.
- 1. If the number of revolutions of the VERNIER control is *less than two* on

either side, the converter was locked on one of the tones rather than the carrier ((e) above).

- 2. Rotate the VERNIER control until another signal element passes through zero beat. Repeat the procedures outlined in (f) and (g) above to determine whether the circuit is tuned properly.
- 3. If it is noted ((f) and (g) above) that the rotation in one direction is more than 2 revolutions of the VERNIER control, and rotation in the other direction was less than 2 revolutions, the carrier would be the signal element which was more than 2 revolutions from the starting point. This new signal element should now be considered the new starting point for the procedures given in (e) above. It is necessary then to check only one more signal element in the same direction of rotation used to move from the original position given in (e) above to the new position. This would determine whether the proper number of revolutions are made before the next signal element enters the carrier channel.
- 4. The new position is now the proper tuning point and the VERNIER control should be set to this position.
- (h) After the carrier signal component has been identified and tuned, turn the AFC switch to the ON position.
- (i) When the converter is locked on the transmitted carrier, the VERNIER control must be rotated slightly more than 2 revolutions on either side of the transmitted carrier. If the VERNIER control is rotated less than 2 revolutions before a new signal element is tuned in, the converter is locked on one of the teletypewriter tones. It must be retuned to another signal element until a condition is reached where more than 2 revolutions of the VERNIER control must be made in either direction before a new signal is tuned in.
- (j) Set the SQUELCH switch of the converter to ON.

- (k) Set the AGC SELECT switch of the converter to TSB.
 - (l) Set the AGC TIME switch of the converter to FAST.
 - (m) Set the MONITOR switch to either A or B and when not monitoring, turn the switch to OFF.
- (4) *Operation for reception of each sideband containing a separate channel of voice intelligence.* To tune the converter to receive this type of signal, proceed as follows:
- (a) Set the receiver controls as indicated in the table below:

Control	Position
BFO switch	OFF
BANDWIDTH switch	16 KC
LOCAL GAIN control.....	5
LIMITER control	OFF
RF GAIN control.....	10
ANT. TRIM control.....	Maximum signal strength as indicated on CARRIER LEVEL meter

- (b) Set the converter controls as described in paragraph 24b.
- (c) Tune in the receiver to the operating frequency.
- (d) Plug in a headset to the MONITOR receptacle of the converter and adjust the MONITOR GAIN control for a comfortable audible level.
- (e) Turn the VERNIER control to set the short line on the disk at +1 KC. A whine will be heard in the headset (like that from a beat-frequency oscillator in a receiver).
- (f) Turn the VERNIER control to move the disk cursor toward its 0 position until the whine disappears from the monitored channel and the CARRIER LEVEL meter indicates a fairly constant reading.
- (g) Turn the AFC switch to ON. The AFC INDICATOR should turn slightly, indicating that the afc circuit in the converter is tracking properly.
- (h) Set the AGC SELECT switch of the converter to CAR.
- (i) Set the AGC TIME switch of the converter to MED.

- (j) Set the MONITOR switch to either A or B position and when not monitoring, turn the switch to OFF.

b. Operation for Reception of Twin Single-sideband Signals, 10-db Reduced Carrier. The operating steps are the same as the steps outlined in *a* above except that the CARRIER COMPENSATOR control is set at 3.

c. Operation for Reception of Single-sideband Signals, 20-db Reduced Carrier.

- (1) *Signals modulated with keyed-tone intelligence.* This type of operation is identical with the operational procedure outlined in *a*(1) above.
- (2) *Signals modulated with voice intelligence.* This type of operation is identical with the operational procedure outlined in *a*(4) above except for the following steps:
 - (a) Set the SB SELECT switch of the converter for the position corresponding to the voice intelligence contained in the sideband.
 - (b) Set the MONITOR switch in the same position corresponding to the voice intelligence contained in the sideband.

d. Operation for Reception of Single-sideband Signals, 10-db Reduced Carrier. The operating steps for 10-decibel (db) reduced carrier signals are identical to operation of 20-db reduced carrier signals (*c* above) except to turn the CARRIER COMPENSATOR control to 3.

e. Operation for Reception of Single-sideband Signals, No Reduction in Carrier. The operating steps are the same as the steps outlined in *c* above except that the CARRIER COMPENSATOR control is set at 1.

f. Reception of Double-sideband Am Signals. This type of operation is identical with the operational procedure outlined in *a*(4) above except that the CARRIER COMPENSATOR control is set at 1.

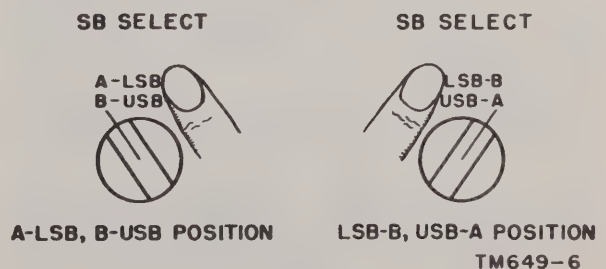


Figure 23. SB SELECT control positions.

27. Operation with Terminal Equipment

In system operation using keyed-tones, the operator at the terminal equipment calls the operator at the receiving set when the signals to the terminal equipment are not normal. The final step of tuning is when the converter output signals are fed to the proper terminal channels, at the correct operating level, and the receiving teletypewriters are printing intelligible messages. The final steps of operation are given below:

a. Setting of SB SELECT Switch of Converter.

- (1) The normal transmission of the teletypewriter intelligence is on the upper sideband. The intelligence is therefore applied to the terminal equipment over line A when the SB SELECT switch is in the LSB-B, USB-A position. To send the same intelligence to the terminal equipment over line B, change the SB SELECT switch to the opposite position.
- (2) If the transmitted teletypewriter intelligence is on the lower sideband, the SB SELECT switch should be in the A-LSB, B-USB position to apply it to the terminal equipment over line A.
- (3) Refer to the table in paragraph 22*b* for the setting of the switch for all types of signals that contain keyed-tones. Also, use the table for settings of the switch for voice output to loudspeakers when voice modulation is used.

b. Setting of VU SELECT and VU RANGE Switches of Converter. The amount of signal amplitude sent to the terminal equipment will be known from instructions given by the terminal station operator. To set controls of the converter in order to feed the correct amount of signal amplitude under normal conditions, follow the steps given below:

- (1) Turn the VU SELECT switch to monitor the converter audio channel that is delivering the teletypewriter intelligence output.
- (2) Turn the VU RANGE switch to obtain a midscale reading on the VU METER.

Caution: Do not use a range that causes the meter to swing off-scale. Heavy overloading of the meter will damage it.

- (3) Refer to paragraph 16*e* for the setting of

A-VC and B-VC controls if the meter reading is too low.

28. Operation of Radio Receiving Set AN/FRR-41

a. Diversity Operation. The operating procedure for the AN/FRR-41 is the same as the procedure for the AN/FRR-40. Operate the set as instructed in paragraphs 25 through 27.

b. Operation as Two AN/FRR-40 Receiving Sets. To operate one receiver and one converter together in the AN/FRR-41, or to use the equipment for the reception of two different single-sideband signals, follow the instructions in paragraph 26 for one converter and one receiver for one of the desired signals. Repeat the procedure using the other converter and receiver for the other sideband signal.

29. Antijamming Instructions

When an operator knows that his receiver is being jammed, he will inform his immediate superior officer of this fact promptly. Under no condition will he cease operating. To provide maximum intelligibility of jammed signals, he will follow the operational procedure indicated in *a* through *e* below.

a. Operate the receiver as outlined in paragraph 25.

b. Adjust the ANT. TRIM control of the receiver for maximum readable output signal.

c. Set the AGC SELECT switch of the converter to the position that gives optimum performance (par. 32*b*).

d. If this step does not provide some degree of signal separation, request a change in frequency and call sign.

e. If the jamming action is such that communication is impossible, the operator should report this fact to his immediate superior but continue to operate.

30. Stopping Procedure

The stopping procedure of the equipment is the same for all types of operation for both the AN/FRR-40 and the AN/FRR-41.

a. Throw the power switch of the converter to OFF.

b. Rotate the FUNCTION switch of the receiver to OFF.

c. Throw the cabinet power switch to OFF.

Section II. OPERATION UNDER UNUSUAL CONDITIONS

31. Operation under Fading Conditions

The following tables show the settings of the converter controls that are used when flat- and selective-type signals are present. Refer to paragraph 55b for a description of these types of signal fading.

a. Relationship Between AGC SELECT and AGC TIME Switches.

Type of signal fading	Switch	
	AGC SELECT	AGC TIME*
Flat.....	CAR	MED
	LSB USB TSB	FAST
Selective.....	CAR	SLOW
	LSB USB TSB	FAST

* Refer to paragraph 32b for settings of the AGC TIME switch when interference from outside signals is present.

b. Relationship Between LC and RC Positions of CARRIER SELECT Switch. Change the CARRIER SELECT switch position from LC to RC under the following conditions:

- (1) In case the 100-kc crystal of the converter becomes inoperative.
- (2) If the phase difference between the carrier and its sidebands causes distortion.

c. Relationship Between CARRIER COMPENSATOR and SB SELECT Controls. The CARRIER COMPENSATOR and SB SELECT controls may be readjusted under signal fading conditions to help maintain a constant signal level. However, do not use these controls as substitutes for the A-VC or B-VC controls. (Refer to par. 16a and e for the original adjustments.) Operate either control, depending on the setting of the AGC SELECT switch, as shown in the table below, so that the reading on its respective meter reads about midscale as an average.

AGC SELECT switch	Contro	Meter
CAR	CARRIER COMPENSATOR	CARRIER LEVEL
LSB, USB, or TSB	SB AGC	VU METER

32. Operation under Signal Interfering Conditions

a. If tuning is difficult under conditions of interference from outside signals, notify the sending station to do one of the following steps:

- (1) Reduce carrier suppression from 20 db to 10 db.
- (2) Change frequency.
- (3) Remove modulation and transmit the carrier only until tuning is accomplished.
- (4) Send voice modulation instead of keyed-tones until the carrier is tuned in.

b. If a strong interfering signal is present when receiving *keyed-tone* signals, use the MED or SLOW setting of the AGC TIME switch. This helps prevent the interference from keying the desired signal.

33. Operation of SQUELCH ALARM Indicator Under Low-Signal Input Conditions

The SQUELCH ALARM lamp lights when the signal level or signal-to-noise ratio of the *carrier frequency* to the converter becomes too low to provide adequate *afc*. When the SQUELCH ALARM lamp is *on*, the *converter afc circuit is automatically disabled*. The squelch system is completely automatic. That is, squelch voltage is applied (and the SQUELCH ALARM lights) when the carrier signal level or carrier signal-to-noise ratio drops below predetermined levels. Similarly, the squelch voltage is removed (and the SQUELCH ALARM extinguished) when the carrier level or signal-to-noise ratio regains a satisfactory value. This accounts for the phenomenon of intermittent SQUELCH ALARM illumination that sometimes occurs during operation. Infrequent flashes of the SQUELCH ALARM lamp during the course of operation are normal. However, *if the SQUELCH ALARM lights and remains lighted, there is no afc*. Proceed as follows to regain control:

a. Observe the converter CARRIER LEVEL meter. If it averages below midscale, set the CARRIER COMPENSATOR control so that it is adjusted for the degree of suppression at the distant transmitter as follows:

Carrier suppression (db)	CARRIER COMPENSATOR control setting
20	6.5
10	3
0	1

b. If the alarm lamp does not go out (and proper tuning procedure has been followed), the received signal is unsuitable for the converter. Notify the transmitting station to reduce the carrier suppression to 10 db. If this is impossible, manually control the converter input frequency by using the VERNIER control to follow the carrier. The terminal equipment, if possible, must be observed for indications of detuning in the converter, and the necessary tuning corrections made.

Note. If the converter agc circuit is operated by the carrier (AGC SELECT switch in CAR position), do not advance the CARRIER COMPENSATOR control to extinguish the SQUELCH ALARM lamp until the AGC SELECT switch is changed to some other position.

34. Operation of Afc DRIFT ALARM Indicator Under Signal-Drift Conditions

The afc DRIFT ALARM lamp is illuminated when the afc circuit has almost reached its limit of frequency-drift compensation. When the afc DRIFT ALARM lamp lights, slowly readjust the VERNIER tuning control on the converter so that the DRIFT INDICATOR returns to 0 KC. It will be noticed that the VERNIER tuning control will have to be moved an amount equal to the amount of error indicated by the DRIFT INDICATOR prior to the start of the adjustment. If this operation is performed carefully, the converter afc circuit will follow the frequency change and the readjustment may be accomplished without any interruption in service. If both the VERNIER control and the DRIFT INDICATOR are at the same end of their scales simultaneously, it will be necessary to set both controls to 0 KC and retune the receiver.

35. Operation under Different Climatic Conditions

The operation of Radio Receiving Sets AN/FRR-40 and AN/FRR-41 may be difficult in

regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In *a* through *c* below, instructions are given on procedures for minimizing the effects of these unusual operating conditions.

a. Operation in Arctic Climates. Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions are given below:

- (1) Handle the equipment carefully.
- (2) Keep the equipment warm and dry.
- (3) When equipment that has been exposed to the cold is brought into a warm room, moisture will start to condense and will continue to do so until the equipment reaches room temperature. This condition may also arise when the room or shelter warms up after a cold night. When the equipment has reached room temperature, dry it thoroughly.

b. Operation in Tropical Climates. When operated in tropical climates, radio equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground or set up in swampy areas, moisture conditions are more acute than normal. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than that of the surrounding air. To minimize this condition, provide adequate ventilation.

c. Operation in Desert Climates.

- (1) Although high temperatures and low humidity are characteristic of desert climate during the day, the drastic fall in temperature at night often causes condensation on the equipment. Use the same procedures outlined in *b* above to insure proper operation of the equipment.
- (2) Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls that may jerk the connections loose or break the lines.

- (3) Be careful to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (par. 41).

Note. To obtain optimum performance from the converter under conditions wherein the *surrounding temperature of the converter carrier filter (FL5) is constant and at a value outside the limits of 60° F. to 100° F.*, it may be desirable to adjust the local carrier oscillator fre-

quency so that it is equal to the center frequency of the pass band of the carrier filter (par. 16*h*). The total variation in the pass band center frequency of the carrier filter, when its temperature is varied from -40° F. to $+132^{\circ}$ F. is less than 15 cycles. The temperature-shifted center frequency of the carrier filter can be determined by the method described in the manual for the Single Sideband Converter CV-157/URR and the local carrier oscillator frequency can be adjusted accordingly.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

36. Tools and Materials Supplied

No tools or materials are furnished as part of Radio Receiving Sets AN/FRR-40 and AN/FRR-41. Special tools, however, are furnished with each receiver and converter unit. Refer to the manuals covering Radio Receiver R-390/URR and Single Sideband Converter CV-157/URR for the tools supplied with these components of the radio set.

37. Tools, Materials, and Test Equipment Required

The following tools and materials are required for organizational maintenance procedures:

a. Tools.

Tool Equipment TE-41.

b. Materials.

Carbon tetrachloride.*

Cheesecloth, bleached, lint-free.*

Paper, sand, flint #000.*

Solvent, Dry Cleaning (SD) (Fed. No. P-S-661a).

Moisture and Fungus Proofing Kit MK-2/GSM.

c. Test Equipment.

Electron Tube Test Set TV-7/U.

Multimeter TS-352/U.

* Part of Tool Equipment TE-41.

Section II. PREVENTIVE MAINTENANCE SERVICES

38. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair since its object is to prevent certain troubles from occurring.

39. General Preventive Maintenance Techniques

- a. Use No. 000 sandpaper to remove corrosion.
- b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

- (1) If necessary, except for electrical contacts, moisten the cloth or brush with solvent (SD); then wipe the parts dry with a cloth.
- (2) Clean electrical contacts with a cloth mois-

tened with carbon tetrachloride; then wipe them dry with a dry cloth.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of fumes is dangerous. Make sure adequate ventilation is provided.

- c. If available, dry compressed air may be used at a line pressure not exceeding 35 pounds per square inch to remove dust from inaccessible places; be careful, however, of mechanical damage from the air blast may result.

Caution: The initial air blast should be directed away from the equipment to prevent possible damage from any foreign matter or condensed moisture that may be in the air line.

- d. For further information on preventive maintenance techniques, refer to TB SIG 178, Preventive Maintenance Guide for Radio Communication Equipment.

40. Use of Preventive Maintenance Forms (figs. 24 and 25)

a. The decision as to which items on DA Forms 11-238 and 11-239 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items in figures 24 and 25 are partially or totally applicable to the AN/FRR-40 and AN-FRR/41. References in the ITEM block refer to paragraphs in the text that contain additional maintenance information. For information concerning the maintenance of the individual component, refer to the applicable manual.

41. Performing Preventive Maintenance

a. Exterior Items (fig. 24).

Caution: Tighten screws, nuts, and bolts carefully. Fittings tightened beyond the pressure for which they were designed will be damaged or broken.

- (1) Check the equipment against the table of components (par. 7), list of running spares (par. 12), and list of additional equipment required (par. 13), to see that no components or parts are missing. Observe the general condition of the equipment.
- (2) Check the suitability of location and installation for normal operation (fig. 6).
- (3) Use a clean, lint-free cloth to remove dust, dirt, and moisture from the headsets, loudspeakers, front and rear panels, and inside the cabinet.
- (4) Check the seating of fuses located at the rear of the receiver. Check the seating of tubes and crystal holders.
- (5) Inspect all controls for binding, scraping, or excessive looseness. Check those controls with detent mechanisms for positive action.
- (6) Check for normal operation of the receiving set (par. 26).
- (7) Clean and tighten the panel and track mountings that hold the components in the cabinet. Inspect the connection of the antenna lead-in cables, ac power cables,

if. interconnecting cables, age cables, headset and loudspeaker plugs, power plugs in the receptacle strip, and teletypewriter output connecting cables (figs. 17 and 31). Remove any dirt or moisture that may have accumulated on these connectors. Use Multimeter TS-352/U to make continuity checks on the cables and cords.

- (8) Inspect the cabinet and the components for signs of moisture and corrosion. Remove rust spots with No. 000 sandpaper. Touch up the bare spots (par. 45).
- (9) Inspect interconnecting cords and cables for shorts, cuts, tears, kinks, mildew, or fraying (figs. 17 and 31).
- (10) Inspect the antennas for weather damage, bends, corrosion, loose fit, cracked or broken insulators, and damaged guys. If whip antennas are being used, inspect them for bending. If they are bent, straighten them. If they cannot be straightened, replace them. Replace broken ceramic insulators or, in rhombic antennas, damaged termination resistors.
- (11) Check for looseness of the front panel control switches and knobs of the receiver and converter components. Tighten with tools supplied with the components.
- (12) Clean the jewel assembly of the converter pilot lamp, the glass windows of the frequency indicators and converter meters, and the nameplates and caution plates mounted on the components and cabinet.
- (13) Inspect the glass of the meters and the frequency indicators for breakage. Be sure the screws that hold this glass in place are not loose.
- (14) Inspect the operating shelter for adequacy of weatherproofing.
- (15) Check the antenna guy wires for proper tension.
- (16) If deficiencies noted are not corrected during inspection, indicate action taken for correction.

b. Internal Items (fig. 25).

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect the power and check for satisfactory operation.

- (1) Inspect the glass tube envelopes for cracks or accumulation of dirt. Press the tubes

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT **RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR**

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE

EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION						
		S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (receiver, transmitter, connecting cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories). PAR. 410(1)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 410(2)							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHECKS, WAVE, JACKS, PLUGS, TELEPHONES, GARRING-BAGS, COMPONENT PANELS. PAR. 410(3)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRACKS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 410(4)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 410(5)							
6	CHECK FOR NORMAL OPERATION. PAR. 410(6)							

WEEKLY

NO.	ITEM	COND- TION	NO.	ITEM	COND- TION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, GROUND MOUNTS , ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES , AND CABLE CONNECTIONS. PAR. 410(7)	13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.		
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 410(8)	14	CLEAN AIR FILTERS, ORANGE NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 410(12)		
9	INSPECT CORD, CABLE, WIRE, AND GROUND MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 410(9)	15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 410(13)		
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS . PAR. 410(10)	16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER-PROOFING. PAR. 410(14)		
11	INSPECT CANVAS ITEMS, LEATHERS, AND CORDING FOR MILDEW, TEARS, AND FRAYING.	17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION. PAR. 410(15)		
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWER-STATS, RELAYS, RELAYS , MOTORS, BLOWERS, CAPACITORS, GENERATORS , AND PILOT LIGHT ASSEMBLIES. PAR. 410(11)	18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.		
19	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR. 410(16)				

DA FORM 11-238
1 MAY 51

REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

Figure 24. DA Form 11-233.

TM 649-14

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT			
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR			
INSTRUCTIONS: See other side			
EQUIPMENT NOMENCLATURE		EQUIPMENT SERIAL NO.	
LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ② Defect corrected. NOTE: Strike out items not applicable.			
NO	ITEM	NO	ITEM
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (receiver, transmitter, carrying cases, wire and cable, microphone, tubes, spare parts, technical manuals and accessories). PAR. 410(1)	19	ELECTRON TUBES - INSPECT FOR 10000-0000000, 000-00000-0000, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; 0000-000000-000000-0000-0000. PAR. 410(1)
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 410(2)	20	INSPECT FILM CUT-OUTS FOR LOOSE BARRS, DIRT, MISALIGNMENT AND CORROSION.
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, MICROPHONES, JACKS, PLUGS, MICROPHONES, CARRYING CASES, COMPONENT PANELS. PAR. 410(3)	21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 410(2)
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, GROUPEL, FUSES, CONNECTORS, 00000000, 0000-00000-0000-0000-0000-0000. PAR. 410(4)	22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND WING PARTS. PAR. 410(3)
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, BORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 410(5)	23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. PAR. 410(4)
6	CHECK FOR NORMAL OPERATION. PAR. 410(6)	24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR. 410(5)
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 410(7)	25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. PAR. 410(6)
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 410(8)	26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 410(7)
9	INSPECT CORD, CABLE, WIRE, AND 00000-000000 FOR CUTS, BREAKS, PRAYING, DETEIORATION, KINKS, AND STRAIN. PAR. 410(9)	27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. PAR. 410(8)
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT; DAMAGED INSULATORS AND ROPE-CLIPPING. PAR. 410(10)	28	CHECK SETTINGS OF ADJUSTABLE RELAYS. PAR. 410(9)
11	INSPECT CANVAS ITEMS, LEATHER, AND 000000 FOR HILDER, TEARS, AND PRAYING.	29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER. PAR. 410(10)
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, 000000000, RELAYS, 000000, MOTORS, BLOWERS, CAPACITORS, 000000000, AND PILOT LIGHT ASSEMBLIES. PAR. 410(11)	30	INSPECT GENERATORS, AMP CYCLES, 00000000, FOR BRUSH WEAR, SPRING TENSION, 00000, AND FITTING OF COMMUTATOR.
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEAKS AND SPECIFIC GRAVITY, AND DAMAGED CASES.	31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOSES, POTENTIOMETERS, AND RHEOSTATS. PAR. 410(11)
14	CLEAN AIR FILTERS, 00000 NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 410(12)	32	INSPECT TRANSFORMERS, CHOSES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR. 410(12)
15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 410(13)	33	BEFORE SHIPPING OR STORING - 000000 BATTERIES.
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. PAR. 410(14)	34	INSPECT CATHODE RAY TUBE FOR 00000 SCREEN SPOTS.
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION. PAR. 410(15)	35	INSPECT BATTERIES FOR 00000 AND 00000 CELLS.
18	CHECK TERMINAL BOX 00000 FOR CRACKS, 00000, DAMAGED GASKETS, DIRT AND GREASE.	36	INSPECT FOR LEAKING 000000000 000000, BORN OR LOOSE PARTS.
19	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR. 410(16)	37	MOISTURE AND FUMINGPROOF. PAR. 410(13)

DA FORM 11-239

REPLACES DA-660 FORM 439, 1 DEC 50, WHICH IS OBSOLETE.

16-50-00000-1

TM 649-15

Figure 25. DA Form 11-239.

firmly, but gently, straight down in their sockets. Do not jiggle the tubes from side to side because this may break the pins or spread the contacts of the socket. Inspect the tube sockets at times when removal of the tubes is required. Refer to paragraph 46 for checking tubes.

- (2) Inspect terminals of the large fixed capacitors of both the receiver and the converter for corrosion and loose connections. Carefully inspect the mountings to discover loose mounting screws, studs, or brackets. Examine leads for poor insulation, cracks, and evidences of dry rot. Cut away the frayed strands on the insulation. If wire is exposed, wrap it with friction tape. Check to see that the terminals of the capacitors are not cracked or broken. Thoroughly inspect the case of each large fixed capacitor for leaks, bulges, and discoloration. Clean all dirty or corroded connections. Capacitor cases and bushings can usually be cleaned with a dry cloth; however, if the deposit of dirt is hard to remove, moisten the cloth in solvent (SD).
- (3) Inspect the relay in the converter and the antenna and break-in relays of the receiver to see that they are free from dirt or dust; that the contacts are not burned, pitted, or corroded; that the contacts are lined up and spaced correctly; see that the moving parts travel freely and function properly; that the connections to the relays are tight and that the wire insulation is not frayed or torn; make sure that the relay assemblies are mounted securely and that the field coils show no signs of overheating. Examine the relay contacts with the aid of the flashlight. Tighten all loose connections and mounting screws, but do not apply enough force to damage the screws or break the parts they hold. Brush the exterior with a soft brush. If it is very dirty, clean it with a brush dipped in solvent (SD). If contacts are dirty or corroded, remove, clean, and replace them carefully. Instructions for adjusting the relays are given in the respective manuals.
- (4) Inspect variable capacitors for dirt, moisture, misalignment of plates, and loose mountings.

- (5) Inspect all resistors for blistering, discoloration, and other signs of overheating. Inspect the coating of the cement-coated resistors for signs of cracks and chipping. Inspect all leads, but be careful not to move resistors with delicate pigtail leads because these leads may break at the point where they enter the resistor body. Resistors with discolored bodies indicate that they are overloaded, and there may be circuit trouble which requires analysis and correction.

Note. When fungiproofed resistors are heated, a harmless brown stain may appear.

- (6) Inspect the terminals of capacitors and resistors for corrosion, dirt, and loose contacts.
- (7) Inspect the mechanical action of each switch. Look for signs of dirt and corrosion at all exposed elements of the switch. Examine ganged switches to see that their shafts are lubricated properly and that the electrical contacts are clean. This inspection is visual. Do not pry the leaves of the switch apart. The rotary members should make good contact with the stationary members, and as the former slides into the latter, a spreading of the stationary contact leaves should be noticed. Clean the exterior surfaces of switches with a stiff brush moistened with solvent (SD).
- (8) Inspect the terminal blocks and strips for loose connections, cracks, and breaks.
- (9) Check the setting of the relay (K1) of the converter. Refer to the manual for Single Sideband Converter CV-157/URR.
- (10) No lubrication is performed on the receiver at the organizational maintenance level. Consult the converter manual for detailed lubrication instructions.
- (11) Clean and tighten connections and mountings for transformers, motor, potentiometers, and rheostats.
- (12) Inspect the transformers, motor, potentiometers, and rheostats for signs of overheating. Inspection should be made soon after shutting down the equipment.
- (13) Check the adequacy of the moisture-proofing and fungiproofing treatment.

Section III. LUBRICATION

42. Lubrication under Normal Conditions

Lubrication instructions for the receiver and converter components of this equipment are given in the individual manuals covering each component. No lubrication is required for the electrical equipment cabinet.

43. Lubrication under Unusual Conditions

The effects of extreme cold and heat on lubrication materials and lubricants are explained in TB SIG 69, Lubrication of Ground Signal Equipment. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders in the respective component manuals when operating equipment under conditions of extreme cold or heat.

Section IV. WEATHERPROOFING

44. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is fully explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72, Tropical Maintenance of Ground Signal Equipment. The equipment is given the moistureproofing and fungiproofing treatment at the factory and it is necessary to repeat the treatment only when parts are replaced or repaired.

c. Arctic Maintenance. Special precautions necessary to prevent poor performance or total failure of equipment in extremely low temperatures are explained in TB SIG 66, Winter Maintenance of Signal Equipment, and TB SIG 219, Operation of Signal Equipment at Low Temperatures.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are fully explained in TB SIG 75, Desert Maintenance of Ground Signal Equipment.

45. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section V. TROUBLESHOOTING AT ORGANIZATIONAL LEVEL

46. Electron Tube Replacement Procedure

To prevent the possibility of discarding serviceable electron tubes, follow the procedures described below:

a. Inspect all cording and cabling, connections, and the general condition of the equipment before attempting removal of electron tubes.

b. If possible, isolate the trouble to a particular unit or section of the equipment.

c. Use Electron Tube Test Set TV-7/U and test first the tubes suspected of causing the trouble, then test the other tubes one at a time. Substitute new tubes only for those which are defective.

d. If a tube tester is not available, troubleshoot by the tube substitution method as follows:

- (1) Replace the suspected tubes, one at a time, with new tubes. Note the tube and the corresponding socket as different sections of the equipment may use the same tubes. Many tubes used for audio purposes may not work in radio-frequency (rf) stages such as the channel A and B audio output tubes and heterodyne oscillator tube of the converter. Therefore a mixup of these tubes could create a new source of trouble.
- (2) Reinsert the remaining original tubes, one at a time, in the original sockets. If equipment failure occurs during this step, discard the last original tube. Do not leave a new tube in a socket if the equipment operates satisfactorily with the original tube. If practicable, retain any removed tube until its condition is checked by a tube checker.
- (3) If there is an insufficient number of spare tubes, perform the following procedures:
 - (a) Substitute a new tube for one original tube. If there is no different or just a slight difference, remove the new tube and replace it with the original one. Similarly, check each original tube, in turn, until the equipment becomes operative.
 - (b) Often it is possible to remove a tube from one section of the equipment without affecting another section from operating. Providing these tubes are identical, use this tube as a substitute tube in the defective section if there are no new ones available. Also, the tube used in the defective section can be placed in the working section which will act as a tube tester in this capacity. If the working section continues to operate satisfactorily, the tube will be good.
 - (c) If a replacement for a bad tube soon becomes defective, refer to the component manuals, and check the adjustment and condition of component parts of the tube circuit. *The trouble must be found before any more tube substitution is done.*
- (4) Keep a tube that has been in use a long time. Length of service does not necessarily mean it has to be thrown out. Satis-

factory operation of the tube in the equipment is the proof of its condition.

- (5) Do not discard a tube that reads on or near the minimum requirements for that tube. A certain percentage of new tubes barely pass the lower limits of the allowable tolerance.
- (6) Use special care when removing tubes from their sockets. Do not rock a tube in its socket; this may cause the pins to become broken, bent out of shape, or make intermittent connections.

47. Visual Inspection

a. Many of the faults that appear in the AN/FRR-40 and AN/FRR-41 may be detected by a visual inspection of the system components. With a multimeter, check as many of the items below as is practicable before starting a detailed examination of the components.

- (1) Burned-out fuse.
- (2) Defective tube.
- (3) Faulty input connections.
- (4) Faulty output connections.
- (5) Faulty power cable.
- (6) Line voltage low or not applied.
- (7) Grounded or broken antenna or antenna lead-in.

b. Another type of fault is the improper setting of switches and controls. Check the switch and control settings for the type of operation being used. If different antennas are being used for various operating frequencies, check to see that the correct antennas are connected for the frequency at which reception is being attempted.

48. System Sectionalization of Trouble to Component

a. System sectionalization consists of determining whether the trouble lies in the receiver, the converter, or in the interconnecting facilities between them and also checking the connections between them and the cabinet.

b. Operate the entire receiving set to observe its performance. Refer to the equipment performance check list (par. 50) for normal operating indications.

- (1) If the entire equipment is inoperative and the pilot lamps do not light, the trouble is

probably in the power source or at the switch box in the electrical equipment cabinet.

- (2) If only one component is completely inoperative, the trouble is in that component. If it is the receiver, the trouble may be only a fuse. If it is the converter, the trouble may be an open circuit breaker. If upon the replacement of the fuse, or the resetting of the circuit breaker, the same trouble re-occurs, do not replace the fuse or reset the circuit breaker again until the real source of trouble is determined.
- (3) If the signal, as indicated by proper meter readings, audible indications, etc., is present in the receiver, but not in the converter, the trouble may be a defective connector or interconnecting cable.
- (4) The antenna and antenna lead-in can be checked by observing the CARRIER LEVEL meter of each receiver. Each receiver should give some indication of input signal when tuned to a known station. Interchanging the antenna lead-ins and checking results can determine which antenna system, if any, is defective.
- (5) If one receiver exhibits unsatisfactory performance, such as excessive noise, howling, or weak signals, replace it with a good receiver. If the trouble disappears, the replaced receiver is defective. If the trouble persists, the receiver is not at fault.
- (6) Correct operation of the receiving set as a whole is indicated by proper meter readings on the receiver and converter. When the reproducing devices that operate from the output of the carrier terminal equipment are inoperative, the trouble probably lies in the carrier terminal equipment, its interconnecting cables, or the reproduction devices. This part of the system should be checked, using the appropriate manuals as a guide.

c. By using the procedures similar to the simple checks given above, the trouble usually can be isolated to a particular component of the receiving set. When performing these checks, make full use of the organizational maintenance section of the individual manuals covering the receiver and converter. If these tests are not productive, use the

equipment performance checklist (par. 50) as explained in paragraph 49.

49. Troubleshooting by Using Equipment Performance Checklist

a. *General.* The equipment performance checklist (par. 50) will help the operator to locate trouble in the equipment. The chart gives the component to be checked, the conditions under which the component is checked, the normal indications of correct operation, and the corrective measures the operator may take. The operations listed in the chart should be followed in sequence. When checking the performance of the AN/FRR-41, run through the check list twice; once for one converter-receiver unit, and a second time for the second converter-receiver unit.

b. *Action or Condition.* The action or condition column of the table refers either to a control setting under which the component must be checked or to an action that must be taken to obtain the normal indication listed.

c. *Normal Indications.* The normal indications listed include the visible and audible signs the operator should perceive when the equipment is operating properly. If the indications are not normal, the operator should apply the necessary corrective measures.

d. *Corrective Measures.* The corrective measures listed are those the operator may make without turning the equipment in for repairs. A reference in the check list to a paragraph or another manual indicates that the trouble probably cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative, or if the recommended corrective measures do not yield results, trouble-shooting is necessary. However, if the tactical situation requires that communication be maintained and if the set is not completely inoperative, the operator must attempt to maintain the set in operation as long as it is possible to do so.

e. *Associated Manuals.* Since manuals have been published on both the receiver and converter, take advantage of them when solving difficulties within one of the receiving set's components. The function of the equipment performance check list (par. 50) is primarily to sectionalize the trouble to one of the individual components. Detailed trouble-shooting procedures for the receiver and the converter are given in their respective manuals.

50. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
R E C E I V E R P R E P A R A T O R Y	1	Cabinet power switch....	Turned on.....		
	2	Antenna.....	Lead-in wire connected....		
	3	Loudspeaker or headset...	Loudspeaker connects to LOCAL AUDIO terminals 6 and 7 or headset plugged into PHONES jack.		
	4	Power Cable Assembly CX-1358/U.	Connected between receiver and cabinet power receptacle.		
	5	IF. OUTPUT J106 50 OHM.	Connected to IF. INPUT receptacle of converter through Cord CG-409E/U.		
	6	AUDIO RESPONSE switch.	Set at MED.....		
	7	BANDWIDTH switch...	Set at 16 KC.....		
	8	RF GAIN control.....	Set at 10.....		
	9	LOCAL GAIN, LINE GAIN, and LIMITER controls	Set at 0.....		
C O N V E R T E R P R E P A R A T O R Y	10	Power Cord CD-370.....	Connected between converter and cabinet power receptacle.		
	11	Age Cord CD-135.....	Connected between receiver and converter.		
	12	IF. INPUT receptacle....	See item 5.....		
	13	TB1 terminal 1, 2, and 3 (channel A output); 4, 5, and 6 (channel B output).	Properly connected to terminating equipment.		
	14	CARRIER COMPENSATOR control.	Turn to 6.5 (20-db point)...		
	15	DRIFT INDICATOR control.	Turn to 0 KC position....		
	16	A-VC and B-VC controls.	Set to deliver correct input voltage to terminal equipment as instructed in paragraph 16e.		
	17	VERNIER control.....	Set at 0 KC position.....		
	18	RANGE COMPENSATOR control.	Set at 9 (fig. 10).....		

	Item No.	Item	Action or condition	Normal indications	Corrective measures
C O N V E R T E R P R E P A R A T O R Y	19	MONITOR jack	Headset or loudspeaker plugged in.		
	20	MONITOR switch	Rotate to OFF position		
	21	MONITOR GAIN control.	Turn to 4 or 5		
	22	SB SELECT switch	Set at LSB-B, USB-A position.		
	23	VU SELECT switch	Rotate to OFF position		
	24	VU RANGE switch	Set at +10 DB position		
	25	SQUELCH switch	Set at OFF position		
	26	AFC switch	Set at OFF position		
	27	AGC SELECT switch	Set at REC position		
	28	CARRIER SELECT switch.	Set at LC position		
R E C E I V E R S T A R T	29	SB AGC control	Turn to 7.5		
	30	AGC TIME switch	Set at MED position		
R E C E I V E R S T A R T	31	FUNCTION switch	Turn to AGC position	Dial lamps light. Turn LOCAL GAIN control to about 5 and listen for a rushing noise or signal.	Check power cable, dial lamps, FUNCTION switch, and fuses on receiver and power cable, switch, and fuses of cabinet. Refer to manual.
	32	Power switch	Throw to ON position	Dial lamp (green) lights . . . Power switch remains in ON position.	Check lamp and power cord. Check circuit breaker. Refer to manual.

Item No.	Item	Action or condition	Normal indications	Corrective measures
33	MEGACYCLE CHANGE control.	Set to each band, in turn...	Normal signal output on each band.	Rotate control several times to clean switch contents.
34	KILOCYCLE CHANGE control.	Tune across a band	Signals received. CARRIER LEVEL meter indicates strength of signal.	Refer to manual.
35	ANT. TRIM control	Rotate control	Obtain peak indication on CARRIER LEVEL meter for each band.	
36	RF GAIN control	Rotate control	Audio output and CARRIER LEVEL meter indication increases or decreases.	Refer to manual.
37	FUNCTION switch	Turn to MGC position	With no signal input, noise level should increase and CARRIER LEVEL meter does not show an indication.	Refer to manual.
		Turn to AGC position, and tune through several different signals.	Output volume nearly constant.	Reset ANT. TRIM control. Refer to manual.
		Turn to CAL position, and then operate KILOCYCLE CHANGE control.	Deflection to the right on CARRIER LEVEL meter at each 100-kc reading.	Refer to manual.
		Turn FUNCTION switch to SQUELCH position, and then operate KILOCYCLE CHANGE control.	No reception of noise while tuning between stations.	If noise is high, turn RF GAIN control counter-clockwise until squelch circuit is effective enough to reduce the noise. Refer to manual.
		Return FUNCTION switch to AGC position and RF GAIN control to 10, at completion of this check.		

	Item No.	Item	Action or condition	Normal indications	Corrective measures
C O N V E R T E R P E R F O R M A N C E	38	MONITOR switch.....	Rotate to A position if teletypewriter signal is in transmitted upper sideband; rotate to B position if in lower sideband.	Keyed-tone signals heard in headset or loud-speaker.	Vary VERNIER control in both directions. Check cord and plug of headset or loudspeaker. Check tubes in converter (refer to manual).
	39	MONITOR GAIN control.	Rotate control in either direction.	Audio level increases or decreases.	Refer to manual.
	40	VERNIER control.....	Operate the converter (par. 28).	Keyed tones drop in pitch and disappear out of the monitored channel.	Refer to manual.
	41	MONITOR switch.....	Turn to alternate channel position. (Refer to item 38 above.)	Voice signal is clearly audible, if voice signal is being transmitted.	Refer to manual.
	42	AFC switch.....	Turn to ON position.....	DRIFT ALARM lamp remains unlighted. AFC INDICATOR oscillates slightly. DRIFT INDICATOR may or may not move; vary VERNIER slightly and DRIFT INDICATOR should track; adjust VERNIER for DRIFT INDICATOR setting of 0 KC.	Check tuning of converter and/or receiver. Refer to manual. Check operation according to paragraph 26.
	43	SQUELCH switch.....	Turn to ON position.....	SQUELCH ALARM lamp remains unlighted or lights briefly and goes out.	Advance CARRIER COMPENSATOR control. Should normally be set at 6.5. Check tube V22 (refer to manual).
	44	CARRIER COMPENSATOR control.	Vary control in both directions.	Carrier amplitude increases or decreases as indicated on CARRIER LEVEL meter (adjust for 6.5 reading).	Refer to manual.
	45	SQUELCH ALARM lamp.	Turn receiver RF GAIN control down.	SQUELCH ALARM lamp lights. (Return receiver RF GAIN control to 10, after completing this test.)	Refer to manual.
	46	VU SELECT switch.....	Turn switch to channel that contains keyed-tone intelligence.	Audio signal level is indicated on VU METER.	Refer to manual

	Item No.	Item	Action or condition	Normal indications	Corrective measures
C O N V E R T E R P E R F O R M A N C E	47	VU RANGE switch	Turn to +10 DB position.	Audio output level is 10 vu above VU METER indication.	Refer to manual.
			Turn to 0 DB position	VU METER indicates audio output level.	
			Turn to -10 DB position . .	Audio output level is 10 vu below VU METER indication.	
	48	AGC SELECT switch	Turn to USB position if teletypewriter signal is in the transmitted upper sideband; turn to LSB position if teletypewriter signal is in transmitted lower sideband.		
	49	SB AGC control	Rotate control in either direction.	Signal input to converter increases or decreases as indicated by both VU METER and CARRIER LEVEL meters.	Refer to manual.
	50	CARRIER SELECT switch.	Turn switch to RC position.	If terrain and/or atmospheric conditions are such that normal reception is difficult, some fading may occur and reception may be noisy; otherwise, there will be no noticeable difference.	Refer to manual.
C O N V E R T E R S T O P	51	Power switch	Throw to OFF position . . .	Turns off all converter circuits.	
R E C E I V E R S T O P	52	FUNCTION switch	Turn to STAND BY position.	Receiver is silent. Filament circuits and oscillator circuits are kept on for immediate reception.	
			Turn to OFF position . . .	Turns off all receiver circuits.	
	53	Cabinet power switch . . .	Turn to OFF	No ac power to components.	

CHAPTER 5

SYSTEM THEORY

Section I. THEORY OF SINGLE SIDEBAND SIGNALS

51. General

This chapter describes the theory of single-sideband signals and communication systems using Radio Receiving Sets AN/FRR-40 and AN/FRR-41. Theory concerning the operating relations between Radio Receiver R-390/URR and Single Sideband Converter CV-157/URR is also given. For a detailed description of the theory of these components, refer to their respective manuals. Since the cabinet and installation kit components perform only connecting and supporting functions in the equipment, no specific theory explanation for them is necessary.

52. Basic Principles of Single-Sideband Emission

a. Introduction. Two individual frequency elements make up the structure of any am radio signal. One of these is the carrier frequency; the other is made up of sideband frequencies. Sideband frequencies are formed as a result of the am process. Both an upper and a lower sideband is present in an ordinary double-sideband am signal. The upper sideband frequency is the carrier frequency *plus* the frequency of modulation. The lower sideband frequency is the carrier frequency *minus* the frequency of modulation. Under normal conditions, about two-thirds of the power used to transmit a double-sideband signal is devoted to the transmission of the carrier frequency. Only about one-third of the available transmitter power is used in sending the sideband frequencies. Since one element of range is power, the result of this procedure is to have the carrier frequency (containing no intelligence) travel much farther than the sideband frequencies that actually contain the intelligence. Continuous-wave (cw) emission, frequency-modulated (fm) emission and single-sideband emission may be used to solve this problem. In cw emission, intelligence is transmitted by the on-off keying of

the carrier. For this reason, cw is usually limited to the transmission of a single channel of code intelligence. Fm may be used to transmit any kind of intelligence, but it is used most effectively in the ultra-high-frequency (uhf) and very-high-frequency (vhf) bands of the rf spectrum where range is limited by line of sight. It is in these higher bands that the bandwidth required for satisfactory audio reproduction, using fm techniques, may be obtained. In the high-, medium-, and low-frequency bands, the bandwidth restrictions limit the use of fm. One system of fm that has proved satisfactory in the lower frequency portions of the rf spectrum is frequency-shift keying (fsk). In this system, the carrier is shifted to a definite frequency at either side of a center. One of these frequencies is used to designate the space and the other, the mark impulse used in the operation of automatic reproduction devices such as teletypewriters. To receive signals over great distances, fsk is satisfactory. However, fsk is an inefficient method of transmission on the rf spectrum. The only type of multiplexing that may be used with fsk is time division multiplexing which is limited, in most applications, to about four channels of teletypewriter intelligence. Multiplexing is readily obtained through frequency differentiation, rather than time impulse differentiation, and fsk cannot be used for the former.

b. Principles of Single-Sideband Emission. Of the three systems devised to increase the range of radio transmitters without increasing their rated power output, only single-sideband emission uses am. In am, sidebands are produced that equal the carrier frequency *plus* the frequency of modulation and the carrier frequency *minus* the frequency of modulation. Of such a signal, all that need arrive at the receiving station is *one* of these sidebands. The carrier frequency and the other sideband frequency are both *unnecessary*, since they absorb power at the transmitter but convey no more addi-

tional intelligence than a single sideband. In its pure form, a single-sideband signal takes advantage of this simple theory. The carrier and one sideband are completely suppressed; therefore, only a single sideband is transmitted. The result is that the intelligence travels farther without any increase in the rated power output of the transmitter. However, the carrier frequency should be present at the receiving station for the intelligence to be demodulated from an rf to an audio frequency (af). This is done by having an oscillator produce a substitute carrier frequency which is mixed with the incoming sideband signal for demodulation.

c. *Principles of Reduced Carrier Emission.* In the pure type of single-sideband transmission described above, the carrier and one sideband are completely suppressed to gain a maximum transmitted signal range with minimum transmitter power. This system has one disadvantage: when a precise audio frequency is necessary, the system becomes unsatisfactory. The sidebands of an ordinary double-sideband radio signal consist of the carrier frequency plus the modulation frequency and the carrier frequency minus the modulation frequency, therefore, this implies a fixed *relationship* between the sideband frequencies and the carrier frequency. When the carrier frequency drifts, the sideband frequencies drift with it, maintaining their *relative* frequency to the carrier, but changing their *absolute* frequency. In single-sideband transmission, where the carrier is substituted at the end of the system, the transmitter drift will produce a change in the audio-frequency output of the receiving system. The substitute carrier frequency introduced at the system receiving end remains fixed, while the absolute frequency of the received sideband frequency changes. Thus, a change in *relative* frequency is produced, which results in a change in the *absolute* af output of the receiving system. Therefore, some kind of standard should be provided so that compensations may be made for transmitter output frequency drift. This is done by reintroducing the carrier frequency at the transmitter end of the system, at a *reduced* level. The receiving system has a standard that establishes the sideband frequency in relation to its carrier and can therefore, through proper circuitry, compensate to produce an audio output of the correct absolute frequency. Where the carrier is reduced and used as a control signal, many of the increased range benefits of pure single-sideband transmission are

retained. In addition, a correct audio output from the receiving system is achieved.

d. *Principles of Twin Single-Sideband Emission.* The term twin single-sideband emission is used throughout this manual to indicate another application of the principle of single-sideband emission. In twin single-sideband emission, both the upper and the lower sidebands are transmitted together with a reduced carrier, but each of the sidebands contains different intelligence. In this application, a radio signal, occupying no more of the rf spectrum than an ordinary double-sideband am signal, may be used to convey twice the intelligence of the ordinary signal. In addition, an increase in range, depending on the amount of carrier suppression, is gained over ordinary double-sideband signals. The reduced carrier is included in the transmitted signal for use at the receiver as a control signal (c above). The converter may be used to receive this type of signal. It has the filters and the output connections necessary to separate the independent sidebands of the received signal and to deliver the intelligence contained in these sidebands as separate audio outputs from the converter. It is possible to use frequency differentiated multiplexing (multichannel) techniques *within each sideband* of the transmitted signal. A twin single-sideband signal may be used to carry simultaneously several channels of teletypewriter intelligence, as well as a channel of voice and a channel of facsimile. The signal does not necessarily have to carry this combination of intelligence. The options (par. 4) that may be used are practically limitless.

e. *Summary.* The use of the various forms of single-sideband radio communication provides two distinct advantages over ordinary double-sideband methods.

- (1) *Multichannel operation.* By placing separate intelligence on each sideband of a transmitted rf carrier, a greater amount of intelligence may be communicated while occupying the same portion of the rf spectrum as was previously used to carry only a single tone or voice channel.
- (2) *Increased range.* By devoting a maximum of power to the transmission of the intelligence containing sideband frequencies, and only a small amount of power to the transmission of the carrier which contains no intelligence, a gain in effective transmitter range is achieved without increasing the rated power output of the transmitter.

Section II. THEORY OF COMMUNICATION SYSTEMS USING RADIO RECEIVING SETS AN/FRR-40 AND AN/FRR-41

53. Single-Sideband Communication Techniques

a. Audio intelligence may be transmitted using any one of the forms of single-sideband emission described in paragraph 52. The function of either the AN/FRR-40 or the AN/FRR-41 receiving set in the system is to receive and demodulate the intelligence.

b. When voice intelligence is transmitted, loudspeakers or headsets may be operated directly from the converter output of the receiving set. In a signal where only one sideband is used, a single channel of voice intelligence may be transmitted. When a twin single-sideband signal is used, two different voice channels may be transmitted.

c. When using single-sideband emission, teletypewriter and facsimile intelligence is usually transmitted in the form of audio tones. For the facsimile signal, a tone of one frequency represents white copy and another tone represents black copy. Other tones in between represent shades of gray. For the teletypewriter signal, a tone of one audio frequency represents the current-on, a tone of another audio frequency represents the current-off, an impulse common to any on-off keyed automatic reproduction device. In frequency diversity, it is possible to place as many as eight sets (of two tones each) in *each channel of the receiving set*. Thus, eight channels of teletypewriter information may be received when one sideband of a single-sideband signal is being transmitted and this number may be doubled when a twin single-sideband signal is used. When using space diversity, 16 channels of teletypewriter information may be transmitted on one sideband of a single-sideband signal. The function of the receiving set is to receive the transmitted signal and demodulate it into the audio tones present in it. Thus, teletypewriters *cannot be operated directly from the receiving set* and, therefore, it is necessary to feed the audio tones to specialized carrier terminal equipment that translates the audio tones into the current-on, current-off impulses that actually operate the automatic reproduction devices. When a twin single-sideband signal is used, it is not necessary to devote both sideband channels to the reception of one kind of intelligence. One sideband may be used for the transmission of teletypewriter intelligence, the other for facsimile or speech and a voice order wire, etc.

54. Twin Single-Sideband Communication Systems Using AN/FRR-40 (figs. 26 and 27)

a. Figure 26 shows the multichannel characteristic inherent in a twin single-sideband communication system. In the illustrated system, message intelligence is transmitted by using a 2-kc tone in the upper sideband and a 1-kc tone in the lower sideband. These two frequencies are chosen arbitrarily as examples to demonstrate later that the tones may be keyed separately. Thus, the two tones might be used to carry messages in International Morse Code, or, through any on-off keying system.

b. In tracing the signal path shown in figure 26, note that the transmitted upper sideband is produced by modulating one output of the transmitter master oscillator with a 2-kc tone, then filtering out both the carrier and the lower sideband frequencies produced in the modulation process. To produce the transmitted lower sideband, a second output of the master oscillator is modulated with a 1-kc tone, and all mixer products produced in the modulator, except the lower sideband frequency (.999 mc), are then removed in filters.

c. The sidebands are then recombined with the carrier that is usually reduced. The degree of reduction depends on transmitting conditions and the system used. The signal thus formed appears at the antenna as a 1-mc carrier frequency, having an upper sideband of 1.002 mc and a lower sideband of .999 mc.

d. In Radio Receiver R-390/URR, the transmitter output frequency is converted to an if. of 455 kc, having an upper sideband of 457 kc and a lower sideband of 454 kc. These sidebands, as detected and amplified in the receiver audio-output stages, will be heard only as a mixture of 1-kc and 2-kc tones, their harmonics, subsequent mixtures, etc. Thus, the if. output of the receiver must be fed to Single Sideband Converter CV-157/URR to enable the transmitted sidebands to be separated.

e. The output of the fifth receiver if. amplifying stage is fed through a cathode follower to a mixer in the single-sideband converter, where it is mixed with the output of the converter heterodyne oscillator. Because the frequency of the converter heterodyne oscillator is above the receiver if., a *sideband inversion* takes place; that is, the 457-kc upper

sideband input from the receiver is converted to appear below the 100-kc if. center of the converter as 98 kc. The transmitted lower sideband, delivered to the converter as 454 kc, becomes 101 kc. This inversion of the sidebands always takes place when the converter is used in conjunction with Radio Receiver R-390/URR or any other receiver having an input conversion sequence similar to this receiver.

f. The converter if. is now fed to three filters that separate its three frequency components. A peaked 100-kc filter selects the converter carrier for *reconditioning* and afc use. Two band-pass filters select the upper and lower sidebands for amplification. After amplification, the sidebands are recombined with the locally generated carrier. The combination is then demodulated and fed to the audio output circuits of the converter where, depending on the position of the SB SELECT switch, the 1-kc tone appears as the channel A audio output and the 2-kc tone as the channel B audio output. The filters that separate the upper and lower sideband frequencies have a pass band of 6 kc. Thus, in actual operation, the many tones forming the sideband frequencies will pass through these filters to be demodulated and finally delivered as the audio output of the converter.

g. Figure 27 shows another twin single-sideband communication network. The principle of the system shown in figure 27 is the same as that in figure 26, except that frequency shift (fs) audio tones are used instead of the 2-kc upper sideband, and a voice channel has been substituted for the 1-kc lower sideband. The dc pulse outputs of two standard sending teletypewriters are fed to a tone keyer. The character of the tone keyer varies from system to system, but basically, the teletypewriter mark current pulse in channel 1 is used to key a tone oscillator of one af, and the space pulse keys a tone oscillator of another frequency. Two different tones are used to carry the mark and space impulses of the sending teletypewriter in channel 2. The tones produced in the tone keyer might arbitrarily be selected to be 1 kc (channel 1 mark), 1.5 kc (channel 1 space), 2 kc (channel 2 mark), and 2.5 kc (channel 2 space). The pass band of the sideband filters in the single-sideband converter limits the frequency range of the tones that may be used. (No tone above 6 kc may be used.) The separating equipment into which the single-sideband converter output is fed limits the number of teletypewriter

channels that may be placed within this pass band (how close the tones may be to one another in frequency).

h. Figure 27 shows that the carrier is modulated with the varied frequency output of the tone keyer. The upper sideband is selected to be mixed with the carrier for transmission. The transmitted lower sideband has been produced in precisely the same way as the transmitted lower sideband illustrated in figure 26, except that voice instead of a 1-kc tone is being transmitted. The sidebands that contain the teletypewriter and voice-transmitted intelligence go through the same sequence of reception (including the sideband inversion) as the 2-kc and 1-kc sidebands in figure 26. Emerging from channel A of the converter, the teletypewriter tones are fed to terminal equipment that converts them to the dc pulses necessary to operate receiving teletypewriters. The voice signal appears at channel B of the converter output (demodulated and separated from the other elements present in the transmitted signal), and may be fed direct to a headset or any other audio-frequency reproducing device.

i. Any rf carrier, amplitude-modulated with a 2-kc tone, produces a double-sideband signal. One sideband is a frequency 2 kc above the center, or carrier frequency; the other, 2 kc below the carrier frequency. Demodulation of this signal in an ordinary radio receiver will produce a receiver audio output of 2 kc. Demodulation of the signal in Single Sideband Converter CV-157/URR will produce two 2-kc notes; one is demodulated from the upper sideband and delivered through channel A output and the other, from the lower sideband delivered as an audio output from channel B. Nothing is gained by separating the sidebands in a converter, because the same intelligence can be received through any ordinary radio receiver. However, in the presence of interfering signals on multipath propagation (fading), considerable improvement in the received signal can be obtained by selecting the better sideband signal from the converter.

55. Diversity Systems

a. *General.* Diversity operation improves radio reception by overcoming the effects caused by the relatively short-term fading of radio signals. The improvement usually is accomplished by selection of the better signal of the diversity group. In some cases, two separate signals containing the same in-

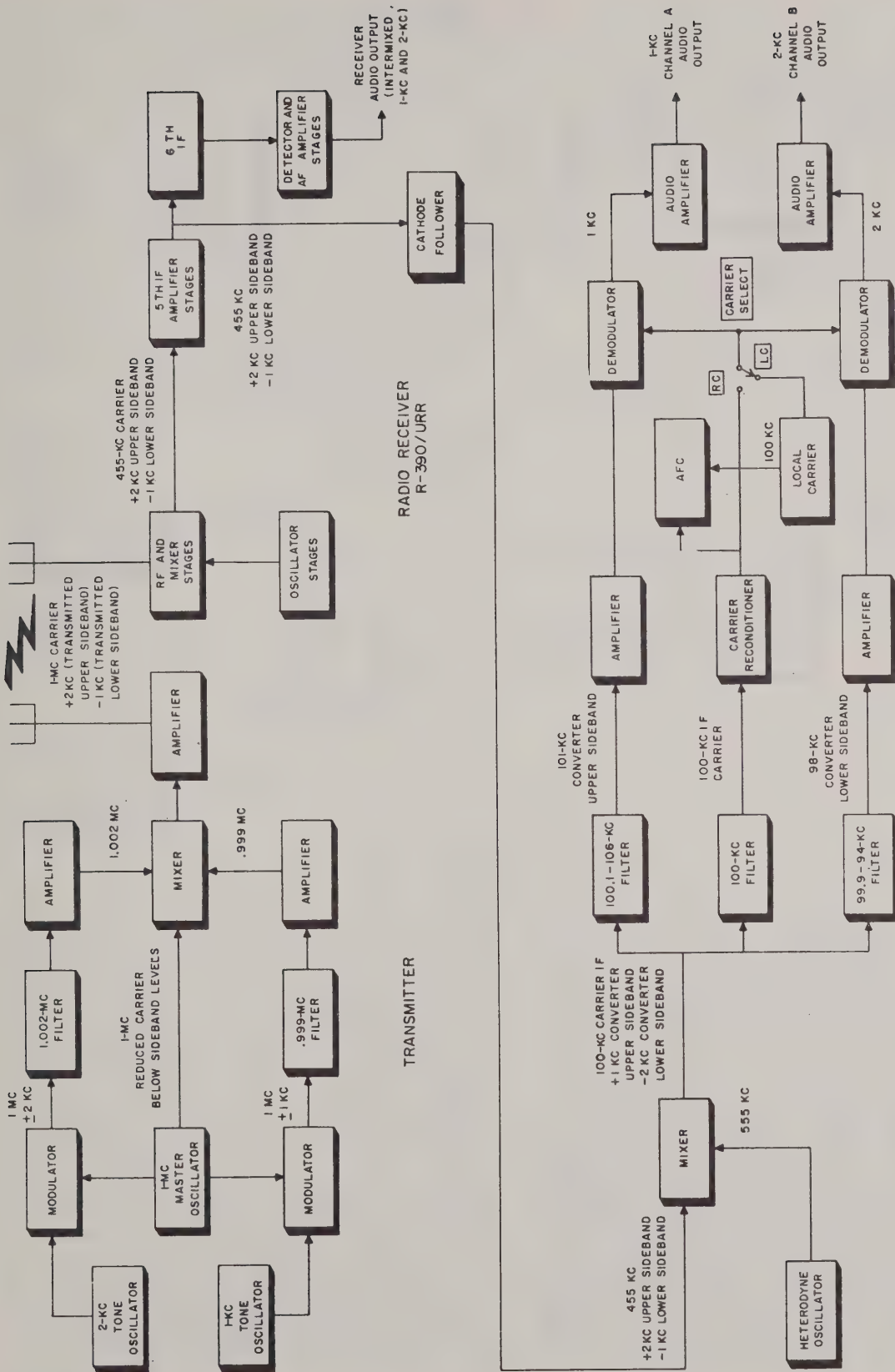


Figure 26. Twin single-sideband system, tone modulation, block diagram.

SINGLE SIDEBAND CONVERTER
CV-157/URR

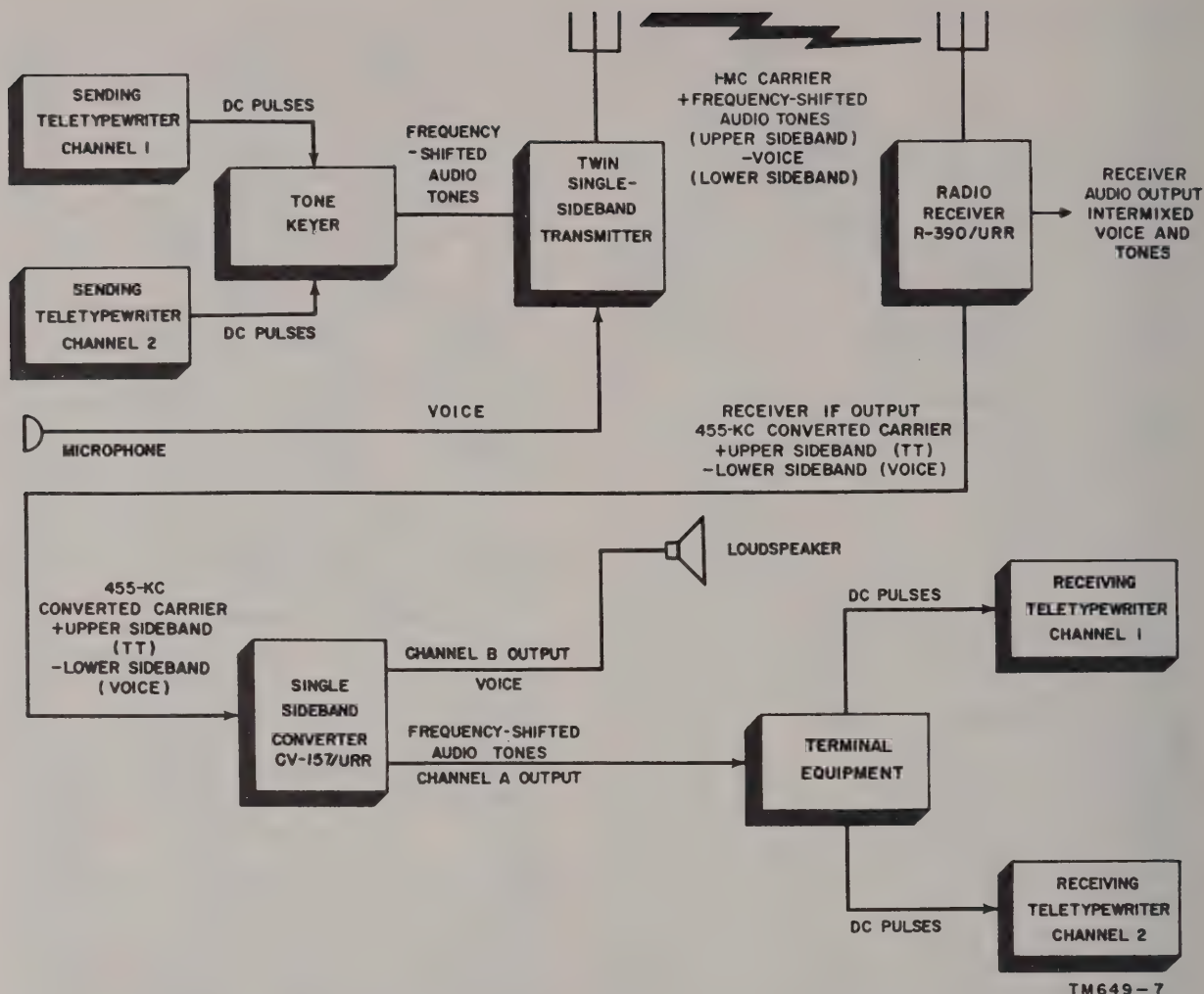


Figure 27. Twin single-sideband system, frequency-shift tones and voice modulation, block diagram.

telligence are transmitted, with one of the signals eventually being compared against the other. This method is known as *frequency diversity*. In other applications, a single transmitted signal is received at two geographically separated antennas and the signal that is delivered from one antenna is compared to that of the other. This method is called *space diversity*. In both methods, the more satisfactory of the two available signals received is selected. The continuous reception of a satisfactory signal is especially necessary in the operation of a multiplex radioteletype communication system. *Instantaneous* signal fading is not tolerable in a teletypewriter signal. The loss of mark or spaces pulse will throw the sequentially operated teletypewriter selector magnet into a cycle of incorrect operation. This results in the loss of part of a

message. This effect of instantaneous fading may be largely overcome through the use of *voice-frequency diversity* (a type of frequency diversity) prior to modulation at the transmitter.

b. *Signal Fading*. Fading is an undesirable characteristic common to all radio signals. In the medium- and high-frequency bands, one type of fading is caused by the periodic shifting in the altitude of the ionosphere. This change in altitude causes a change in the skip distance of the radio signal and a change in the absorption loss in the ionosphere and results in a temporary decrease of signal strength. This type of fading is known as *flat fading*. A more prominent cause of fading is the arrival of the transmitted signal at the receiving antenna by two or more different paths. When this occurs, the different received signals containing

the same intelligence vary in phase and amplitude and periodically tend to cancel and aid each other. This results in a temporary decrease and increase in received signal strength. In this type of fading, the entire signal does not fade at once. This type of fading is known as *selective fading*.

c. Space Diversity. Space diversity is the most frequently used method of obtaining the benefits offered by diversity operation. A radio signal will not simultaneously fade at two points separated by a distance of at least 600 feet. In dual space-diversity reception, a single transmitted signal is received by two antennas positioned at least 600 feet apart. Each antenna is used for a separate receiver and means are provided for making a comparison of the outputs of the receivers and for the selection of the output least affected by signal fading.

d. Frequency Diversity. Frequency diversity is based on the theory that two signals of different frequency will not simultaneously fade at the same point. There are two types of frequency diversity: radio-frequency (broad band) diversity and voice-frequency (narrow band) diversity.

(1) Radio-frequency diversity involves the transmission of two separate radio signals containing identical intelligence. These two signals are transmitted at different frequencies. The frequency difference existing between these two transmitted frequencies must lie within the radio-frequency spectrum. The two transmitted signals are received at a single antenna which is connected, through a multicoupler, to two receivers. One receiver is tuned to one incoming frequency; the other receiver is tuned to the other incoming frequency. As in space diversity, a comparator of some kind is provided to select the receiver with the instantaneous better output. Radio-frequency diversity is seldom used in actual practice because it requires the use of two transmitter installations.

(2) Voice-frequency diversity, like radio-frequency diversity, involves two signals of different frequency, carrying identical intelligence. In voice-frequency diversity, however, the difference in frequency existing between the diversified signals is normally less than 6 kc; this is an *audio*

frequency. These signals both may be amplitude-modulated on a single rf carrier when the diversified signals are audio frequencies. Unlike radio-frequency diversity signals, voice-frequency diversity signals may be transmitted by using a single transmitter. At the receiving end of the system, a single antenna and receiver are used and comparison for the purpose of selecting the better of the diversified signals carrying intelligence is made in the carrier terminal equipment. Since only one radio signal is present and it is received by one antenna, voice-frequency diversity will not overcome the fading effect caused by a shift in the altitude of the ionosphere. Voice-frequency diversity, therefore, is not as effective in preventing flat fading as radio-frequency diversity with sufficiently separated rf carriers. Voice-frequency diversity, considering all the factors, is entirely satisfactory since it effectively overcomes any cancellation effects resulting from the arrival of the transmitted signal at the receiving antenna by two or more paths.

56. Diversity System Using AN/FRR-40

Single Sideband Converter CV-157/URR is equipped with two filters in each output circuit. The operator may limit the bandpass of the converter output circuits to 3.5 kc or 6 kc. The wider bandpass is used for voice- or audio-frequency diversity multiplex teletypewriter signals, to enable the system in which the converter is used to take advantage of the nonfading characteristics of this type of signal. Comparison between the signals is made by the carrier terminal equipment and not by the receiving set. The AN/FRR-40 is not used for the reception of space and radio-frequency diversity signals.

57. Radio Receiving Set AN/FRR-41 as Used in Communication Systems

The AN/FRR-41 consists of two electrically independent AN/FRR-40 receiving sets mounted in a single cabinet. Consequently, the theory of the AN/FRR-41 is essentially the same as that discussed in paragraphs 54 and 55. The AN/FRR-41 is intended primarily for use in space- and radio-frequency diversity applications. Each receiver-converter group is used to receive one of the avail-

able signals, whether delivered from two antennas (in space diversity) or through a single antenna, from two transmitters (in radio-frequency diversity). In such applications, the outputs of the two converters are fed to the necessary carrier terminal equipment that compares these outputs and selects

the better for the eventual operation of automatic reproduction devices (fig. 3). It should be pointed out that the AN/FRR-41 could be used in a setup where voice-frequency diversity is used in combination with radio frequency or space diversity. Such a combination is called a *double-diversity* system.

Section III. RADIO SET THEORY

58. Relationship Between Receiver and Converter in Radio Receiving Sets AN/FRR-40 and AN/FRR-41

a. Receiver If. Output and Converter Input (fig. 28). Between the fifth and sixth if. amplifying stages of the receiver, part of the if. signal is tapped off and fed to an isolating tube, V511B, the circuit of which is shown in figure 28. Tube V511B is a cathode follower and provides a low-impedance output at coaxial connector J106. The if. signal voltage developed across resistor R550 is coupled through capacitor C538 and delivered through the receiver internal connectors J512 and P112 to J106. The signal then passes through Cord CG-409E/U to the converter IF INPUT receptacle, J1. Resistor R1, in the converter, is provided to match the converter input circuit to the impedance of the interconnecting cable. INPUT GAIN potentiometer R2 (par. 16b) enables the amplitude of the converter input signal to be varied for efficient mixing in mixer V1.

b. Agc Circuit. Figure 29 illustrates the interrelationship that exists between the agc circuits of the converter and those of the receiver when AGC SELECT switch S10 is in the CAR position. Switch S10 is a rotary-type switch that has two sections, A and B. With S10 in the CAR position, agc voltage is developed by the 100-kc signal appearing across the capacitive dividing network of C94 and C95 in the plate circuit of the second carrier amplifier, V18. This signal is applied to terminal 3 of S10A and through the switch rotor to terminal 1. From terminal 1, the signal is connected through coupling capacitor C154 through terminals 9 and 7 of S10A to the control grid of first age amplifier V36. The amplified output signal of V36 is coupled through C158 to the grid (pin 7) of second age amplifier V37A. The output of V37A is coupled through C160 to the plate of age rectifier V37B, a diode-connected triode. The cathode of V37B is biased through the network comprised of resistors

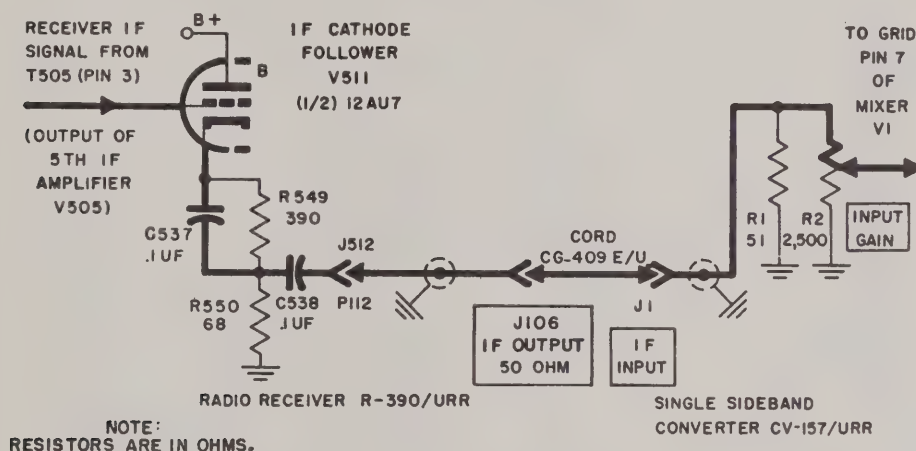
R230, R232, R233, and R234 and AGC THRESHOLD potentiometer R231. The cathode of V37B is connected to the arm of potentiometer R231, and as the arm of R231 is varied toward the junction of R230 and R233, the cathode V37B becomes more positive. As the arm is varied toward R232 and R234, the cathode of V37B becomes more negative. The dc output of the rectifier is fed through isolating resistor R227 and is applied across AGC OUTPUT control R228. In any position except the REC position of S10, the bias on the grids of tubes V201, V202, V501, and V505 in the receiver is controlled by the setting of the AGC OUTPUT control. This bias voltage is, of course, changed by the conduction of rectifier V37B and hence by AGC THRESHOLD potentiometer R231. The arm of R228 is connected through resistor R229 to AGC TIME switch S11. Switch S11, shown in the SLOW position, allows the operator to select various reaction times for the agc circuit to make the system usable on signals that have widely different characteristics. The time constant of the circuit is determined by the discharge rate of the capacitor selected by S11 through R228 and R229. The larger the capacitance, the slower the circuit reaction time. In the FAST position of S11, there is appreciably no time delay in the reaction of the circuit since no capacitance is introduced to the circuit by S11 except that introduced by stray capacitance of the wiring. In the MED position, S11 selects C166, a 1-microfarad (μf) capacitor, and the agc reaction time is delayed approximately 1 second. In the SLOW position, the 12- μf capacitor C165 causes a reaction delay of about 15 seconds. From S11, the agc voltage is fed to terminals 11 and 12 of S10B, the second half of S10. From S10B, the agc voltage is applied to the receiver through terminal 7 of TB2. Terminal board TB2 is located on the rear panel of the converter. In addition to terminal 7, terminals 8 and 9 on TB2 are used to enable the agc circuits of the converter and the receiver to be

interrelated. Terminal 8 is the ground connection for the age, and terminal 9 is tied back to terminal 7 when S10 is in the REC position. These three terminals (7, 8, and 9) of TB2 are connected through age Cord CD-135 to terminals 3, 4, and 7 of TB102 located on the rear panel of the receiver. The age voltage present at terminal 7 of TB2 is connected to terminal 4 of TB102 and applied to the control grids of first rf amplifier V201, second rf amplifier V202, first if. amplifier V501, and fifth if. amplifier V505. Terminal 8, age ground, of TB2 is connected to terminal 7 of TB102. Terminal 9 of TB2 is connected to terminal 3 of TB102, making terminals 3

and 4 common when AGC SELECT switch S10 is in the REC position. When terminals 3 and 4 of TB102 are common, it is the voltage developed in the receiver age circuit that is applied as bias to the grids of receiver tubes V201, V202, V501, and V505.

59. Electrical Equipment Cabinet CY-1119/U

The electrical equipment cabinet has been fused and wired with convenience outlets to provide power to the receiver and converter components mounted in it. Figure 30 is a schematic diagram of the cabinet wiring.



TM 649-19

Figure 28. Receiver if. output and converter input stages, functional diagram.

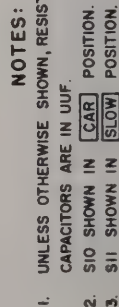
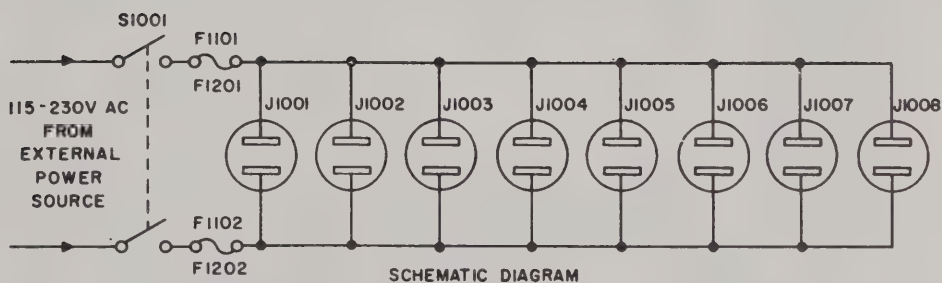


Figure 29. Relationship of converter to receiver age circuit, functional diagram.



NOTES:

1. IN THE AN/FRR-40, F1101 AND F1102 ARE 10 AMP FUSES WITH 115V AC OPERATION.
2. IN THE AN/FRR-41, F1201 AND F1202 ARE 15 AMP FUSES WITH 115V AC OPERATION SUPPLIED.
3. WITH 230V AC OPERATION, REPLACE THE 10 AND 15 AMP FUSES WITH 5 AND 8 AMP FUSES, RESPECTIVELY.

TM649-8

Figure 30. Electrical Equipment Cabinet CY-1119/U, schematic diagram.

CHAPTER 6

SYSTEM FIELD MAINTENANCE

Note. This chapter contains information for system field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the technician making the repair.

60. Troubleshooting Procedures

a. General. The first step in servicing a defective receiving set is to sectionalize the fault. Sectionalization means tracing the fault to the major component responsible for the abnormal operation of the receiving set. The second step is to localize the fault. Localization means tracing the fault to the defective item responsible for the abnormal condition. This chapter is concerned only with system maintenance; that is, with tracing the trouble to a particular component. When the trouble has been isolated, the repairman should then refer to the manual covering the faulty component.

b. System Sectionalization. Set up the receiving set for operation by following the steps given in the procedure for reception of a twin single-sideband signal (par. 26a). Check the operation of the components against the equipment performance check-list (par. 50) until an abnormal indication is noted. Refer to the system troubleshooting chart (par. 65), which will often quickly indicate the item causing the trouble and the corrective measures to be taken. If the charts do not give sufficient information, the trouble must be localized within the defective component.

c. Localization. Localization is the tracing of an equipment fault to a particular item. Localization of trouble within a component of the receiving set may best be accomplished by following the instructions in the receiver and converter individual manuals furnished with the equipment.

61. Troubleshooting Data

The material supplied in this manual will aid in the rapid sectionalization of faults. For detailed information about the receivers and converters, use the manuals furnished with the individual components that make up the equipment (par. 66).

Fig.	Par.	Description
17, 31	19	Connections.
	Radio Receiving Sets AN/FRR-40 and AN/FRR-41, cording diagram rear view.
	50	Equipment performance check list.
	65	System troubleshooting chart.
30	67	Signal substitution notes.
	Electrical Equipment Cabinet CY-1119/U, schematic diagram.

62. Test Equipment Required for Troubleshooting

The test equipment required for testing the receiving set consists of the equipment listed in paragraph 37c. Test equipment required for troubleshooting the individual units is listed in the manuals covering the receiver and the converter.

63. Checking Tubes

a. Tube Failures. Tube failures are responsible for a large percentage of the faults that occur in a radio set. Do not attempt to find the source of trouble in the receiving set by indiscriminately changing and testing tubes. Test the tubes, by using Electron Tube Test Set TV-7/U, or by substitution techniques only when localization to a stage indicates tube testing to be a logical step (par. 46).

b. Tube Checking. Tube checkers are used to check either the emission or the mutual conductance of a tube and to test for shorted elements within the tube. Remember that the results obtained by using the tube checker are not obtained under the same conditions as those under which the tube operates in the receiving set. For this reason, the final test of a tube must be its comparison in the receiving set with a substituted tube that is known to be good.

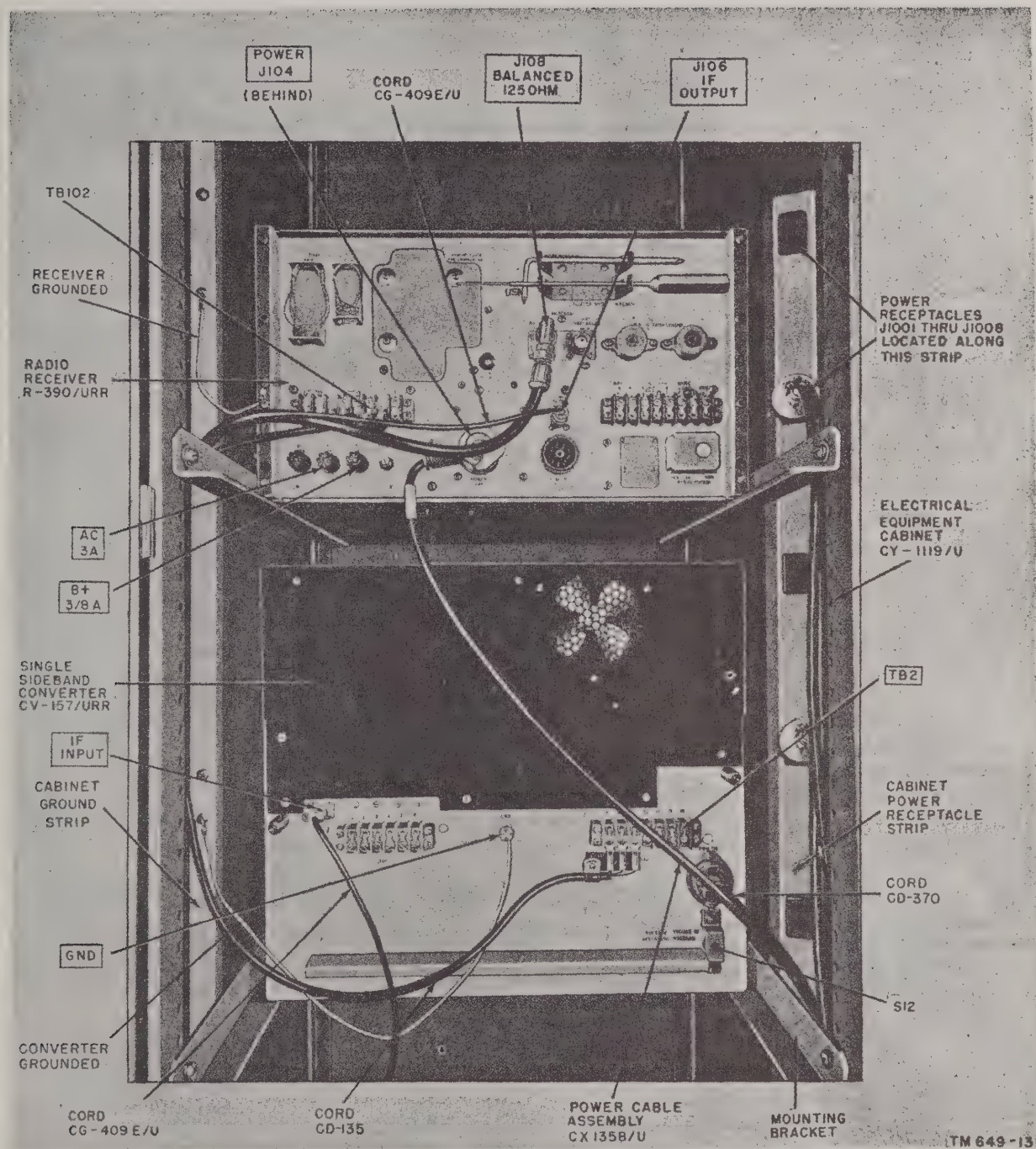


Figure 31. Radio Receiving Sets AN/FRR-40 and AN/FRR-41.

64. Operational Test

a. If the item of equipment being repaired is installed as part of the AN/FRR-40 or AN-FRR/41, operate the equipment in accordance with the equipment performance checklist (par. 50). The checklist frequently indicates the general location of trouble. Refer to the troubleshooting chart (par. 65) to locate a possible source of trouble. More detailed information can be obtained from the individual equipment manuals.

b. If a component is being checked apart from

its receiving set, follow the troubleshooting procedure described in the individual equipment manuals.

65. System Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in the AN/FRR-40 and AN/FRR-41. This chart lists the symptoms that the repairman may observe while operating the equipment. Follow the operating procedure described in paragraph 26. The chart is set up for the AN/FRR-40. To use it with the AN/FRR-41, run through the items for one associated converter and receiver, then repeat the process for the other receiver and converter.

Symptom	Probable trouble	Correction
1. No panel lamps light with FUNCTION switch at AGC on the receiver and power circuit breaker at ON on the converter.	Trouble at power source or in the cabinet.	Check power source for voltage. Check line connection terminals in fuse box. Check connection at power source. Repair or replace power cable.
	Power switch in cabinet in OFF position.	Place switch in ON position.
	Fuse(s) in switch box defective.	Replace defective fuse. If fuse immediately blows upon replacement, disconnect power source and make continuity check between fuse sockets, while, one at a time, disconnecting components from cabinet receptacle strip to discover shorted component. Also check fuses for 230-volt operation use on 115-volt source.
2. Receiver panel lamp not on but converter panel lamp lights.	Defective dial lamp.	Check and replace dial lamp.
	Receiver not properly connected at receptacle strip in cabinet.	Check connection of receiver to cabinet receptacle strip and Power Cable Assembly CX-1358/U.
	AC 3A fuse (receiver) defective.	Replace fuse at receiver rear panel.
3. Receiver dial lamp lights, but receiver CARRIER LEVEL meter does not deflect. No reception with RF GAIN and LOCAL GAIN controls set at 10.	No B+ voltage. 3/8A fuse (receiver) defective.	Replace fuse at receiver rear panel. If fuse blows once more, refer to receiver manual.
	Antenna shorted or disconnected.	In AN/FRR-41, check by interchanging antenna leads between receivers. In AN/FRR-40, substitute receivers.
	Any tube or component in rf, mixer, and oscillator stages.	Turn FUNCTION switch to CAL position and if indication occurs on the CARRIER LEVEL meter, these components are good. If no indication, check tubes on tube tester and refer to receiver manual to check other components.

Symptom	Probable trouble	Correction
4. No receiver output to converter. CARRIER LEVEL meter of receiver has indication but converter CARRIER LEVEL meter remains at 0. Signal is heard at PHONES jack of receiver.	Defective component in cathode-follower stage in receiver.	Check tube (V511). Refer to receiver manual to check other components.
5. No calibration signal when FUNCTION switch is set at CAL.	Defective calibration oscillator component.	Check tube (V901). Refer to receiver manual to check other components.
6. No beat frequency is heard when BFO switch is turned ON and BFO PITCH control is varied. <i>Note.</i> All of the following information refers to Single Sideband Converter CV-157/URR.	Defective bfo stage.	Check tube (V508). Refer to receiver manual to check other components.
7. Pilot lamp fails to light when power switch is at ON.	Defective lamp. Power Cord CD-370.	Check lamp (I 3). Check cord. Check power receptacle in cabinet.
8. The power switch throws automatically to the OFF position.	Short circuit in converter.	Refer to converter manual.
9. No audio output at MONITOR jack when VU METER indicates audio signal present.	MONITOR GAIN and MONITOR switches improperly positioned. Failure in monitor circuits. No intelligence being transmitted.	Check setting of these controls. Refer to converter manual. Make certain that intelligence is being sent by transmitting station.
10. No indication on VU METER, no audible signal at MONITOR jack for either channel A or B. But CARRIER LEVEL meter indicates properly.	No intelligence being transmitted. Failure of monitor amplifier tube. Failure in local carrier oscillator tube. CARRIER SELECT switch defective. SIDE BAND SELECT switch defective.	Make certain intelligence is actually being transmitted. Check tube (V9). Check tube (V35). Turn CARRIER SELECT switch to RC position. If monitoring facilities indicate signal is now present, refer to manual and make voltage and resistance checks of oscillator stage. Refer to converter manual. Refer to converter manual.
11. No intelligence in either channel indicated by monitoring facilities in both LC and RC positions of CARRIER SELECT switch.	Poorly tuned receiver and/or converter.	Check operating procedure in paragraph 26 for type of signal being received.

Symptom	Probable trouble	Correction
12. AFC INDICATOR shows erratic tracking. Converter continually detuned by afc circuit SQUELCH switch ON.	Converter or receiver improperly tuned. Poor signal being received and squelch circuit has failed.	Check operating instructions (par. 26) for type of operation being used. If possible, check quality of received signal. Check output of receiver if signal input to converter; turn squelch circuit alignment (refer to manual).
13. No agc voltage applied from converter to receiver.	AGC OUTPUT and/or AGC THRESHOLD adjustments improperly made. Cord CD-135 defective. Failure in agc amplifiers or rectifier. Failure in receiver agc system.	Make agc adjustments (par. 16d). Check agc cord and terminal connections. Refer to converter manual. Refer to receiver manual.
14. When AGC SELECT switch is set on one of the converter positions, input signal from receiver is immediately cut off and does not return.	SB AGC control advanced too far. AGC OUTPUT or AGC THRESHOLD adjustments improperly made. Failure in converter agc circuit.	Retard control. Refer to paragraph 16f. Refer to converter manual.
15. No indication on VU METER when signals are audible at MONITOR jack.	VU RANGE or VU SELECT switches improperly positioned. Failure in VU METER amplifying circuit.	Set switch in proper position. Refer to converter manual.

66. Component Troubleshooting

After a fault in the AN/FRR-40 or AN/FRR-41 has been sectionalized to a component by following the system troubleshooting chart (par. 65), the particular item or component part causing the fault must be identified. Detailed troubleshooting procedures for these components and instructions for replacement of defective items will be found in their individual manuals which are listed below:

Equipment	Manual
Radio Receiver R-390/URR.....	TM 11-856
Single Sideband Converter CV-157/URR..	TM 11-266

67. Signal Substitution Notes

In the AN/FRR-41, a defective component or stage may often be localized more quickly by a substitution of input and output signals within the receiving set. It is improbable that both receivers or both converters will fail simultaneously in the AN/FRR-41. For this reason, the receivers and converters feeding one another may be interchanged for test purposes to discover whether a receiver or

a converter has failed. The same technique also may be used to determine if apparent trouble is caused by one of the antenna installations. In the AN/FRR-40, a substitution test of this kind may be made when receivers or converters, known to be in good operating condition, are readily available.

68. Refinishing

Instructions for the refinishing of badly marred panels, cabinets, and cases are available in TM 9-2851, Painting Instructions for Field Use. Refer to the instructions as necessary.

69. Final Testing

Each repaired component of the AN/FRR-40 and AN/FRR-41 should be final tested in accordance with the final testing procedures given in the individual manuals. Any component passing the tests given is suitable for field use. Failure of the component to perform according to these tests indicates that more troubleshooting is necessary. A suitable final test for the assembled equipment is to operate it according to the equipment performance checklist (par. 50).

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

70. Disassembly

The following instructions are intended as a guide for preparing the radio receiving set for shipment and storage.

- a. Remove all outside leads, such as antennas or ground wires.
- b. Disconnect all external cabling.
- c. Remove any headphones.
- d. Remove the receiver(s) and converter(s) from the cabinet.

Note. Because of the weight, two men should be used in removing the converter from the cabinet.

71. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the materials available and the condition under which the equipment is to be shipped or stored. Refer to paragraph 15 and follow the instructions in reverse order.

b. Whenever practicable, place a dehydrating agent, such as silica gel, inside the chests or packing boxes. Protect the chests (or boxes) with a waterproof paper barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected chests in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

72. General

The demolition procedures outlined in paragraph 73 will be followed to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon the order of the commander.

73. Methods of Destruction

a. *Smash.* Smash the crystals, controls, tubes, coils, motors, switches, capacitors, and transformers; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. *Cut.* Cut cables and wiring; use axes, handaxes, or machetes.

c. *Burn.* Burn cables, resistors, capacitors, coils, wiring, and manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. *Bend.* Bend panels, cabinet, and chassis.

e. *Explosives.* If explosives are necessary, use firearms, grenades, or TNT.

f. *Disposal.* Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. *Destroy.* Destroy everything.

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Visual inspection	47	50
Tubes:		
Checking	63	68
Replacing	46	49
Uncrating, unpacking, and checking new equipment	15	14
Unpacking:		
Electrical Equipment Cabinet CY-1119/U	15b	14
General	15a	14
Installation kits for Radio Receiving Sets AN/FRR-40 and AN/FRR-41	15c	15
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Weatherproofing:		
Arctic	44c	49
Desert	44d	49
General	44a	49
Tropical	44b	49

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

MAXWELL D. TAYLOR,
General, United States Army
Chief of Staff

OFFICIAL:

JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

N. F. TWINING,
Chief of Staff, United States Air Force.

OFFICIAL:

E. E. TORO,
Colonel, United States Air Force,
Air Adjutant General.

DISTRIBUTION:

Active Army:

CNGB (1)
Tec Svc, DA (1)
Tec Svc Bd (1)
CONARC (5)
CONARC Bd (Incl ea Test Sec) (1)
Army AA Comd (2)
OS Maj Comd (5)
OS Base Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Tng Div (2)
Ft & Cp (2)
Gen & Br Svc Sch (5) except SigC Sch (25)
Gen Depots (2) except Atlanta Gen Depot (None)
SigC Sec, Gen Depots (10)

SigC Depots (20)
POE (2)
OS Sup Agencies (2)
SigC Fld Maint Shops (3)
SigC Lab (5)
Mil Dist (1)

Units organized under following TOE:

11-7R, Sig Co Inf Div (2)
11-16R, Hq&Hq Co, Sig Bn, Corps or Abn
Corps (2)
11-57R, Armd Sig Co (2)
11-127R, Sig Rep Co (2)
11-128R, Sig Depot Co (2)
11-500R (AA thru AE), Sig Svc Org (2)
11-557R, Abn Sig Co (2)
11-587R, Sig Base Maint Co (2)
11-592R, Hq&Hq Co, Sig Base Depot (2)
11-597R, Sig Base Depot Co (2)

NG: State AG (6), Units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see SR 320-50-1.

TECHNICAL MANUAL

RADIO RECEIVING SETS AN/FRR-40 AND AN/FRR-41

TM 11-649
CHANGE No. 5 }

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 August 1963

TM 11-649, 28 September 1955, is changed as follows:

Note. The parenthetical reference to previous changes (example: page 1 of C 3) indicates that pertinent material was published in that change.

Inside front cover, last line. Below the last line, add the following:

RADIATION HAZARD



STD-RW-2

Co 60
Ni 63
Ra 226

Tube types 0A2, 0A2WA, 5651, and 5651WA contain radioactive material (par. 5). These tubes are potentially hazardous when broken; see qualified medical personnel and the Safety Director if you are exposed to or cut by broken tubes. Use extreme care in replacing these tubes (par. 46) and follow safety procedures in their handling, storage, and disposal.

Never place radioactive tubes in your pockets.

Use extreme care not to break radioactive tubes while handling them.

Never remove radioactive tubes from cartons until ready for use.

Refer to paragraph 70.1 for handling, storage, and disposal of radioactive material.

Page 5, paragraph 5. After the last line add:
Radioactive tubes:

Item	Isotope	Quantity (microcuries)
0A2	Co 60	0.0067
0A2WA	Co 60	0.0067
	Ni 63	0.01-0.05
5651	Co 60	0.0067
5651WA	Ra 26	0.045-0.055
	Co 60	0.0067

Page 44. Delete paragraph 38 and substitute:

38. Scope of Operator's Maintenance

The maintenance duties normally assigned to the operator of the AN/FRR-40 and AN/FRR-41 are listed below together with a reference to the paragraph covering the specific maintenance function. The duties normally assigned require no special tools or test equipment other than those issued with the equipment.

a. Daily preventive maintenance checks and services (par. 41).

b. Operational checks of the AN/FRR-40 and AN/FRR-41 (pars. 26 and 28).

Delete paragraph 39 and substitute:

39. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. *Systematic Care.* The procedures given in paragraphs 41 through 41.4 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

Page 45. Delete paragraph 41 and substitute:

41. Daily Preventive Maintenance Checks and Services Chart

Note. The daily preventive maintenance checks and services are performed with the radio equipment operating as a radio receiver link in a voice and multichannel radioteletype single-sideband or twin single-sideband systems. Perform only those items listed in the chart below.

Sequence No.	Item	Procedure	References
1	End item equipment.....	Inspect equipment for completeness.	App. III and figs. 4 and 5.

b. *Preventive Maintenance Checks and Services.* The preventive maintenance checks and services chart (pars. 41 and 41.4) outlines functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the chart indicates what to check, how to check, and what the normal conditions are. The *references* column lists the illustrations, paragraphs, or manuals that contain supplementary information. If the defect cannot be remedied by the operator, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

Delete paragraph 40 and substitute:

40. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the AN/FRR-40 and AN/FRR-41 are required on a daily basis. Paragraph 41 specifies checks and services that must be accomplished daily and under the special conditions listed below.

a. When the equipment is initially installed.

b. When the equipment is reinstalled after removal for any reason.

c. At least once each week if the equipment is maintained in standby condition.

Sequence No.	Item	Procedure	References
2	Equipment exterior.....	Warning: Cleaning compound is flammable and its fumes are toxic. Do not use near a flame and provide adequate ventilation. Check exterior for cleanliness and remove dust and dirt with a clean lint-free cloth or with a cloth dampened (not wet) with cleaning compound as necessary.	Fig. 1.
3	Handles and mounting screws.....	Check for tightness.....	Figs. 13 and 14.
4	External cables and cords.....	Check for cuts, cracked, or gouged jackets, fraying, bad bruises, or kinks.	Fig. 17.
5	Panel meters	Check for broken glass, sticking meter needles, and loose meter mounting.	Figs. 13 and 14.
6	Power indicator lamps.....	Check for lighted power indicator lamps.	Figs. 13 and 14.
7	CARRIER LEVEL meters.....	Check for correct on-scale meter indication.	Figs. 13 and 14.
8	AFC INDICATOR.....	Check for slight movement to indicate afc operation.	Fig. 14.
9	SQUELCH ALARM and DRIFT ALARM indicators.	Check for unlighted or slow flicker rate of SQUELCH ALARM lamp and for an unlighted DRIFT ALARM lamp.	Fig. 14.
10	MONITOR switch	Check presence of signal in position A and B.	Fig. 14.

Page 46. Delete figure 24.

Page 47. Delete figure 25.

Add paragraphs 41.1 through 41.4

41.1. Scope of Second Echelon Maintenance

The maintenance duties assigned to second echelon maintenance personnel are listed below together with a reference to the paragraph covering the specific maintenance function. The duties assigned require the tools and materials listed in appendix III.

- a. Monthly preventive maintenance checks and services (par. 41.4).
- b. Lubrication (pars. 42 and 43).
- c. Visual inspection (par. 47).
- d. Electron tube replacement (par. 46).

41.2. Preventive Maintenance

a. Preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdowns, and assure maximum operational capability. Preventive maintenance is the responsibility of all echelons concerned with the equipment and includes the inspection, testing, and repair or replacement of parts, subassemblies, or units that inspection and tests indicate

would probably fail before the next scheduled periodic service. Preventive maintenance checks of radio sets at the second echelon level are made at monthly intervals unless otherwise specified or directed by the commanding officer. The preventive maintenance checks and services should be scheduled concurrently with the periodic service schedule of the other equipment in the system.

b. Maintenance forms and records to be used and maintained on this equipment are specified in TM 38-750.

41.3. Monthly Maintenance

Perform the monthly maintenance functions indicated in the monthly preventive maintenance checks and services chart (par. 41.4) once each month. A month is defined as approximately 30 calendar days of 8-hour-per-day operation. If the equipment is operated 16 hours a day, the monthly preventive maintenance checks and services should be performed at 15 day intervals. Adjustment to the maintenance interval must be made to compensate for any unusual operating conditions. Equipment maintained in a standby (ready for immediate operation) condition must have monthly preventive maintenance checks and

services performed on it. Equipment in limited storage (requires service before operation) does not require monthly preventive maintenance.

All deficiencies or shortcomings will be recorded in accordance with the requirements of TM 38-750.

41.4. Monthly Preventive Maintenance Checks and Services Chart

Note. The monthly preventive maintenance checks and services are only performed during an authorized downtime. Do not attempt to perform the procedures below when the radio equipment is operating in a radio system.

Sequence No.	Item	Procedure	References
1	Equipment interior	Check for cleanliness. Clean with lint-free cloth or brush as required.	TM 11-5820-357-20 and TM 11-266.
2	Modifications	Check to see if applicable MWO's have been performed. All urgent MWO's must be applied immediately and all normal MWO's must be scheduled.	DA Pam 310-4.
3	Accessible pluckout parts.....	Inspect seating of pluckout parts and, if necessary, tighten mounting bolts, screws, or nuts.	TM 11-266 and TM 11-5820-357-20.
4	Running spares	Make sure that authorized quantities of running spares are on hand or on requisition.	App. III.
5	Component parts and wiring	Inspect for damage from overheating, and short circuits, and other causes.	Par. 47; TM 11-266 and TM 11-5820-357-20.
6	Drawer slides and catches	Check drawer slides for smooth operation and catches for proper locking.	TM 11-266 and TM 11-5820-357-20.
7	Cabinet and mountings	Check cabinet and mountings for cleanliness, indications of rust and corrosion, and mounting hardware for tightness.	Figs. 4 and 5.
8	Blower motor	Check for signs of damage due to wear, overheating, and other damages.	Fig 31; TM 11-266.
9	Fuses	See that all operating fuses are of proper value.	Figs. 19 and 31. App. III.
10	Preservation	Check painted surfaces for rust and corrosion.	Par. 45.
11	Knobs, dials, and switches.....	While checking for normal operation (item 13) observe that mechanical action of each switch, dial, and knob is smooth and free of external binding.	Figs. 13 and 14.
12	Lubrication	Lubricate equipment	Pars. 42 and 43.
13	Operation	Check for normal operation.....	Par. 50.

Page 49. Delete paragraph 45 and substitute:

45. Touchup Painting

Remove rust and corrosion from metal surfaces by lightly sanding them with sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TM 9-213.

Paragraph 46. After the heading, add the following:

Warning: The 0A2, 0A2WA, 5651, and

5651WA type tubes contain radioactive material. Handle carefully to avoid breakage.

Page 73. After paragraph 70, add paragraph 70.1:

70.1. Handling, Storage, and Disposal of Radioactive Material

Follow the procedures for safe handling, storage, and disposal of radioactive materials as directed by TB SIG 225, AR 40-580, and AR 755-380.

Appendix I (page 1 of C 4). Add the following:

AR 40-580	Medical Service, Control of Hazards to Health from Radioactive Materials.
AR 755-380	Disposal of Supplies and Equipment, Disposal of Unwanted Radioactive Material.
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TB SIG 225	Identification and Handling of Radioactive Signal Items.
TM 9-213	Painting Instructions for Field Use.
TM 11-266	Field Maintenance Single Sideband Converter CV-157/URR.
TM 38-750	The Army Equipment Records and Procedures.

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

DASA (6)
USASA (2)
CNGB (1)
CofEngrs (1)
TSG (1)
CSigO (7)
CofT (1)
CSptS (1)
USA CD Agcy (1)
USCONARC (5)
USAMC (5)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (3)
OS Base Comd (2)
LOGCOMD (2)
USAECOM (5)
USAMICOM (4)
USASCC (4)
MDW (1)
Armies (2)
Corps (2)
USA Corps (3)
USATC AD (2)

USATC Engr (2)
USATC Inf (2)
USATC Armor (2)
USASTC (5)
Instl (2) except
Ft Monmouth (63)
Svc Colleges (2)
Br Svc Sch (2)
GENDEP (OS) (2)
Sig Dep (OS) (12)
Sig Sec, GENDEP (5)
Army Dep (2) except
Ft Worth (8)
Lexington (12)
Sacramento (28)
Tobyhanna (12)
USA Elct RD Actv,
White Sands (13)
USA Elct RD Actv,
Ft Huachuca (2)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
USAOSA (1)

AMS (1)
WRAMC (1)
AFIP (1)
Army Pic Cen (2)
USA Mbl Spt Cen (1)
USA Elct Mat Agcy (12)
Chicago Proc Dist (1)
USARCARIB Sig Agcy (1)
Sig Fld Maint Shop (3)
Units org under fol TOE
(2 cy ea UNOINDC)
11-7
11-16
11-57
11-98
11-117
11-155
11-157
11-500 (Tms AA-AC) (4)
11-557
11-587
11-592
11-597

NG: State AG (3).

USAR: None.

For explanation of abbreviations used, see AR 320-50.

TM 11-649
TO 31R2-2FRR-221 }
CHANGES No. 4

WASHINGTON 25, D. C., 23 April 1963
DEPARTMENTS OF THE ARMY
AND THE AIR FORCE

RADIO RECEIVING SETS AN/FRR-40 AND AN/FRR-41

TM 11-649/31R2-2FRR-221, 28 September 1955, is changed as follows:

Note. The parenthetical reference to previous changes (example: page 1 of C 3) indicate that pertinent material was published in that change.

Page 2, paragraph 1. Delete subparagraph *e*.
Add paragraph 1.1 after paragraph 1.

1.1. Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes or additional publications pertaining to your equipment. DA Pam 310-4 is a current index of technical manuals, technical bulletins, supply bulletins, lubrication orders, and modification work orders that are available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes and revisions of each equipment publication.

Page 2, paragraph 2, (page 1 of C 3). Delete subparagraph *g*.

Delete paragraph 2 and substitute:

2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Comments on Manual. Forward all comments on this publication direct to Commanding Officer, U. S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, N. J. DA Form 1598 (Record of Comments on Publications), DA Form 2496 (Disposition Form), or letter may be used.

Page 73. Add appendix I after chapter 7.

APPENDIX I

REFERENCES

Additional instructions concerning maintenance of this equipment are contained in—

TM 11-5820-357-10, Operator's Manual: Radio Receiver R-390/URR.

TM 11-5820-357-20P, Organizational Maintenance Repair Parts and Special Tools List and Maintenance Allocation Chart: Receiver, Radio R-390/URR.

TM 11-5820-359-12P, Operator and Organizational Maintenance Repair Parts and Special Tools List and

Maintenance Allocation Chart: Power Supply PP-621/URR.

TM 11-5820-276-35P, Field and Depot Maintenance Repair Parts and Special Tools List and Maintenance Allocation Chart: Cabinet, Electrical CY-1119/U; CY-1119A/U.

Appendix I (page 3 of C 3), change to Appendix II.

Appendix II (page 8 of C 3). Add after ALLOCATION OF TOOLS FOR MAINTENANCE

* The changes supersede TM 11-5820-214-10P, 2 March 1960, including C 1, 19 December 1960.

NANCE FUNCTIONS (AN/FRR-41) the attached MAINTENANCE ALLOCATION CHART (CV-157/URR and ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTIONS (CV-157/URR)

Appendix II (page 9 of C 3), change to Appendix III.

APPENDIX III, paragraph 1b(5), line 1, (page 9 of C 3) after "is" add: each, whether annotated or not, and is Appendix III, para-

graph 1b(6), line 2, (page 9 of C 3). After X, add: or not annotated.

Appendix III, paragraph 2 (page 9 of C 3). Delete and substitute:

2. Other Service Stock Numbers

Other service items listed herein are authorized in accordance with AR 700-51.

Appendix III (page 13 of C 3) After Section III add the attached Section IV. Functional Parts List (CV-157/URR)

MAINTENANCE ALLOCATION CHART

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH	(4) 2ND ECH	(5) 3RD ECH	(6) 4TH ECH	(7) 5TH ECH	(8) TOOLS REQUIRED	(9) REMARKS
CONVERTER, SINGLE SIDEBAND CV-157/URR	replace repair rebuild service adjust inspect test align calibrate		X	X		X	9, 10 1, 2, 3, 4, 6, 7, 9 10, 13 1, 2, 3, 4, 5, 6, 7 8, 9, 10, 11, 12 3, 4, 7, 9, 10, 13 3, 4, 7, 9, 10, 13 9 3, 4, 7, 9, 10, 13 3, 4, 7, 9, 10, 13 1, 2, 3, 4, 5, 6, 7	
CABLE, RADIO FREQUENCY	replace			X				
CAPACITOR, FIXED	replace			X				
CAPACITOR, VARIABLE	replace			X				
CAPACITOR, VARIABLE	replace			X		Y		C13 and C10 only
CIRCUIT BREAKER	replace			X				
COIL, RADIO FREQUENCY	replace			X				
CONNECTOR, RECEPTACLE	replace			X				
CONNECTOR, PLUG	replace			X				
COUPLING, FLEXIBLE	replace			X				
CRYSTAL UNIT, QUARTZ	replace	X		X				
DISK, AFC INDICATOR	replace			X				
ELECTRON TUBE	replace	X		X				
FANNING STRIP	replace			X				
FILTER, BAND-PASS	replace			X				
FILTER, LOW PASS	replace			X				
GEAR ASSEMBLY	replace			X				
CONVERTER, SINGLE SIDEBAND CV-157/URR	repair			X		X		

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH	(4) 2ND ECH	(5) 3RD ECH	(6) 4TH ECH	(7) 5TH ECH	(8) TOOLS REQUIRED	(9) REMARKS
CV 157/URR (continued)								
JACK, TELEPHONE	replace			X				
KNOB	replace		X					
LAMP	replace	X						
LENS, INDICATOR LIGHT	replace		X					
LIGHT, INDICATOR	replace		X					
METER, ARBITRARY SCALE	replace			X				
METER, AUDIO LEVEL	replace			X		X		
MOTOR, ALTERNATING CURRENT	replace			X		X		
OVEN, CRYSTAL	replace			X				
POST, ELECTRON TUBE RETAINER	replace		X					
REACTOR	replace			X				
RELAY, ARMATURE	replace			X				
RESISTOR, FIXED	replace			X				
RESISTOR, VARIABLE	replace			X				
RETAINER, ELECTRON TUBE	replace		X					
SHELL, ELECTRICAL CONNECTOR	replace		X					
SHIELD, ELECTRON TUBE	replace							
SOCKET, ELECTRON TUBE	replace	X						
SWITCH, ROTARY	replace			X				
SWITCH, SENSITIVE: SINGLE POLE DOUBLE THROW	replace			X				
SWITCH, TOGGLE	replace			X				
TERMINAL BOARD	replace			X				
TOOL, ALIGNMENT	replace			X				
TRANSFORMER, AUDIO FREQUENCY	replace			X				
TRANSFORMER, POWER	replace			X				
TRANSFORMER, RADIO FREQUENCY	replace			X				
								Use only in 3rd echelon and higher

ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTIONS

(1) TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	(2) 1ST ECH.	(3) 2ND ECH.	(4) 3RD ECH.	(5) 4TH ECH.	(6) 5TH ECH.	(7) TOOL CODE	(8) REMARKS
CV-157/URM (continued)							
AUDIO OSCILLATOR TS-382/U				†	†	1	
FREQUENCY METER FR-67/U				†	†	2	
MULTIMETER ME-6A/U			†	†	†	3	TS-505/U
MULTIMETER TS-352/U			†	†	†	4	AN/URM-105*
				†	†	5	MX-1471/U**
				†	†	6	
OSCILLOSCOPE OS-8A/U				†	†	7	
SIGNAL GENERATOR AN/URM-25				†	†	8	
SOUND ANALYZER TS-615/U				†	†	9	
TOOL EQUIPMENT TE-113		†	†	†	†	10	Note: 3rd echelon maintenance functions may be delegated to 2nd echelon
TOOL EQUIPMENT TE-114				†	†	11	
TRANSFORMER CN-16/U				†	†	12	Fixed level
TUBE TESTER TV-2				†	†	13	
TUBE TESTER TV-7							
* To be standardized (interim item ME-77/U)							
** Shunt used with ME-77/U or AN/URM-105 for current measurements							

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO.	(9) ITEM NO
	5820-503-2594		CONVERTER, SINGLE SIDEBAND CV-157/URR		NX			
			ITEMS COMPRISING AN OPERABLE EQUIPMENT					
			TECHNICAL MANUAL TM 11-266			2		
	Ord thru AGC							
	5120-618-5500		ALIGNMENT TOOL, ELECTRONIC EQUIPMENT: 7 in lg x 1/4 in dia; Steel drive and socket; Sig dwg SM-C-180516; (adjust trans coils)			1		H101
	5995-164-6584		CABLE ASSEMBLY, POWER ELECTRICAL CD-370; Hubbell part No. 7057 one end; Hubbell part No. 7250 other end; Sig dwg SC-D-4105 (power cable)			1		W1
	5995-889-0590		CABLE ASSEMBLY, RADIO FREQUENCY CG-409G/U; uses Cable RG-58C/U; JETDS UG-88E/U ea end; Sig dwg SC-D-68284			1		W2
	5995-538-9030		CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: fanning strip Sig dwg SM-B-180491 one end; fanning strip Sig dwg SM-B-180493 other end; Sig dwg SM-B-180489			1		W3
	5955-667-2663		CRYSTAL UNIT, QUARTZ CR-42/U; 100 re nom freq; MIL-C-3098B			1		Y1
	6240-155-8706		LAMP, INCANDESCENT: 6-8v; 0.15 amp; MIL type MS15571-2; type TB-14			3		X1 X2 X3
	6210-523-5674		LENS, INDICATOR LIGHT: clear; Dialco part No. 81-117 (squelch alarm)			1		X11A
	6210-270-9924		LENS, INDICATOR LIGHT: green; Dialco part No. 81-112 (power)			1		X13A
	6210-247-1778		LENS, INDICATOR LIGHT: red; Dialco part No. 81-111 (drift alarm)			1		X12A
	5955-667-4569		OVEN, CRYSTAL: ac 6.3v, 60 cyc, single ph; Sig dwg SM-C-180269-1 (hold crystal at even temp)			1		H81
	5960-264-3004		SHIELD, ELECTRON TUBE: MIL type TS103U02			24		E11 thru E34
	5960-284-4352		SHIELD, ELECTRON TUBE: MIL type TS103U03			1		E35
	5960-262-0015		SHIELD, ELECTRON TUBE: MIL type TS102U01			3		E36 E37 E38
	5960-295-7652		SHIELD, ELECTRON TUBE: MIL type TS102U03			3		E39 E40 E41
	5120-242-7410		WRENCH, SOCKET HEAD SCREW: 3/32 in; Spec MIL-W-15751 type XV11, Class 1			1		MP5
	5120-198-5401		WRENCH, SOCKET HEAD SCREW: 0.050 in; Fed spec GGG-W-652, type I Class A			1		MP3

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO	(9) ITEM NO
			CV-157/URR (continued)					
	5120-221-2501		KEY, SOCKET HEAD SCREW: 5/64 in; Fed spec GGG-W-652, type I, Class A			1		MP4
	5120-198-5398		KEY, SOCKET HEAD SCREW: 1/16 in; Fed spec GGG-W-652, type I, Class A			1		
			RUNNING SPARE ITEMS					
	5953-667-2663		CRYSTAL UNIT, QUARTZ CR-42/U: 100 kc nom freq; MIL-C-3098B			1		Y1
	5960-503-1880		ELECTRON TUBE: MIL type 0A2WA			1		V44
	5960-262-1703		ELECTRON TUBE: MIL type 5R4WGA			1		V38 V39
	5960-669-6861		ELECTRON TUBE: MIL type 6005/6A05W			1		V10
	5960-262-0132		ELECTRON TUBE: MIL type 6AU6WA Item Nos. V3, V4, V11, V16, V17, V18, V22, V36, V41			3		See desc column
	5960-188-0806		ELECTRON TUBE: MIL type 6BA7			1		V1
	5960-262-0243		ELECTRON TUBE: MIL type 6U8			1		V35
	5960-188-0880		ELECTRON TUBE: MIL type 6X4W			1		V43
	5960-262-0286		ELECTRON TUBE: MIL type 5651WA			1		V42
	5960-262-0185		ELECTRON TUBE: MIL type 5726/6AL5W			1		V23 V24 V25
	5960-193-5145		ELECTRON TUBE: MIL type 5751 Item Nos. V7, V14, V19, V20, V25, V26, V29, V33, V34			3		See desc column
	5960-262-0210		ELECTRON TUBE: MIL type 5814A Item Nos. V2, V5, V6, V8, V9, V12, V13, V15, V21, V27, V28, V30, V31, V37			4		See desc column
	5960-543-1001		ELECTRON TUBE: MIL type 6080WA			1		V40
	6240-155-8706		LAMP, INCANDESCENT: 6-fv; 0.15 amp; MIL type MSI5571-2; type TB14			2		I1 I2 I3

CV-157/URR

By Order of the Secretaries of the Army and the Air Force:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

CURTIS E. LEMAY,
Chief of Staff, United States Air Force.

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R. J. PUGH,
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USAECOM (5)
USAMICOM (3)
USASCC (4)
MDW (1)
Armies (2)
Corps (2)
USA Corps (3)
USATC AD (2)
USATC Engr (2)
USATC Inf (2)
USATC Armor (2)
Instl (2) except
Ft Monmouth (63)
Svc Colleges (2)
Br Svc Sch (2)
GENDEP (OS) (2)
Sig Dep (OS) (12)
Sig Sec, GENDEP (5)
Army Dep (2) except
Ft Worth (8)
Lexington (12)

Sacramento (17)
Tobyhanna (12)
USMA (5)
USASCS (100)
USASESCS (100)
USA Elet RD Actv, White Sands (13)
USA Elet RD Actv, Ft Huachuca (2)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
OSA (1)
AMS (1)
WRAMC (1)
AFIP (1)
Army Pic Cen (2)
USA Mbl Spt Cen (1)
USA Elet Mat Agcy (25)
Chicago Proc Dist (1)
USARCARIB Sig Agcy (1)
Sig Fld Maint Shops (3)
JBUSMC (2)
Units org under fol TOE (2 cy ea UNOINDC)
11-7
11-16
11-57
11-98
11-117
11-155
11-157
11-500 AA-AC (4)
11-557
11-587
11-592
11-597
32-56

NG: None.

USAR: None.

For explanation of abbreviations used see AR 320-50.

DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

RADIO RECEIVING SETS AN/FRR-40 AND AN/FRR-41

TM 11-649
TO 31R2-2FRR-221
CHANGES No. 3

DEPARTMENTS OF THE ARMY,
AND THE AIR FORCE
WASHINGTON 25, D. C., 29 March 1961

TM 11-649/TO 31R2FRR-221, 28 September 1955, is changed as follows:

Inside cover page, warning notice, (as changed by C 1, 20 Jun 56). Change "265-volt dc and 115- to 230-volt ac" to read: **345-volt dc and 115- to 230-volt ac.**

Page 2, Paragraph 2. Add the following:

g. Any comments concerning omissions and discrepancies in Appendixes I and II will be prepared on DA Form 2028 and forwarded direct to the Commanding Officer, U. S. Army Signal Material Support Agency, ATTN: SIGMS-ML, Fort Monmouth, N. J.

Page 4, Paragraph 4, line 17, (as added by C 1, 20 Jun 56). Add a comma after the word "teletypewriter."

Page 7, paragraph 7a, table, component column, lines 15 and 16 (as changed by C 1, 20 June 56).

Change "Size C, A 1106" to read: **Size C, A 1109.**

Change "Size G, A 1107, A 1108, and A 1109" to read: **Size G, A 1107, A 1108, and A 1106.**

Page 8, paragraph 7b, table component and height columns (as changed by C 1, 20 Jun 56).

In lines 15 and 16 under the component column change "Size B, A 1212 and A 1213" to read: **Size B, A 1212 and A 1214.**

Change "Size C, A 1214" to read: **Size C, A 1213.**

In the fourth numeral under the height column change "1 1/3" to read: **3/4.**

Page 8, paragraph 7b, note, (as changed by C 2, 4 Jan 60). Make the following changes.

Change the word "Note" to: **Notes:**

Designate the existing note as "1"

Add the following:

² On Order No. 4051-PP-60:

Angle brackets A1201 through A1208 are not supplied.

Two each of ground straps W1201 through W1204 are supplied.

Four each slotted panhead machine screws 10/32 x 3/8 inches and two each slotted panhead machine screws 6/32 x 3/8 inches are supplied.

Page 10, figure 5. (As added by C 2, 4 Jan 60). Add the following note:

*These changes supersede C 1, 20 June 1956, C 2, 4 January 1960, and so much of DA Supply Manuals SIG 7 & 8 AN/FRR-40, 17 August 1959, and SIG 7 & 8 AN/FRR-41, 13 May 1959, including C 1, 10 February 1960, as pertain to first echelon items.

NOTE:

ON ORDER NO. 4051-PP-60, THE ANGLE BRACKETS SHOWN IN THE INSTALLATION KIT ARE NOT SUPPLIED.

Page 11, paragraph 11. (As deleted and substituted by C 2, 4 Jan 60). Delete the first sentence and substitute: Installation Kits MK-352/FRR-40 and MK-354/FRR-41 are the installation kits for Radio Receiving Sets AN/FRR-40 and AN/FRR-41 respectively. These consist of the connectors, brackets, blank panels, hardware, and fuses necessary to install the components of each equipment in its cabinet as an operating unit. Throughout the manual these will be referred to as the installation kits:

Paragraph 12, last line of "Running spares" column. After "F14-D-15ROA," (as added by C 2, 4 Jan 60) add: (5 fuses on Order No. 4051-PP-60).

Page 18, paragraph 16f (As changed by C 2, 4 Jan 60). Make the following changes:

Subparagraph (6), line 3. Change "550 millivolts" to: **550 microvolts.**

Subparagraph (7), line 2. Change "millivolts" to: **microvolts.**

Subparagraph (9), line 9. Change "LSB" to: **USB.**

Page 19, paragraph 16g(1) (As changed by C 1, 20 Jun 56). In line 3, change "d(4)" to read: **f(4)**. In line 4, change "d(3)" to read: **f(3)**.

Page 19, paragraph 16h(1), line 2 (As changed by C 1, 20 Jun 56). Change the reference "d(4)" to read: **f(4)**.

Page 26, figure 16. (As added by C 2, 4 Jan 60). Add the following note:

NOTE:

ON ORDER NO. 4051-PP-60, ANGLE BRACKETS A1201 THROUGH A1208 ARE NOT SUPPLIED.

Page 33, paragraph 22b (As changed by C 1, 20 Jun 56). Make the following changes:

Line 5. Change the word "right" to read: **Left.**

Line 7. Change the word "left" to read: **right.**

Page 35, paragraph 23b(2), line 2, (As changed by C 1, 20 Jun 56). Change the reference "16e" to read: **16d.**

Page 41, paragraph 31c line 7 (As changed by C 1, 20 Jun 56). Change "16a and e" to read: **16e and g.**

Page 41, paragraph 31c, table (As changed by C 1, 20 Jun 56). Change the heading of the second column "Contro" to read: **Control.**

Page 64, paragraph 58a, line 3 from bottom (As changed by C 1, 20 Jun 56). Change the reference "16b" to read: **16e.**

Page 72, paragraph 65, table, correction column, item 13 (As changed by C 1, 20 Jun 56). Change the reference "16d" to read: **16f.**

APPENDIX I

MAINTENANCE ALLOCATION

(Added)

1. General

a. This appendix assigns maintenance functions and repair operations to be performed by the lowest appropriate maintenance echelon.

b. Columns in the maintenance allocation chart are as follows:

- (1) *Part or component.* This column shows only the nomenclature or standard item name. Additional descriptive data are included only where clarification is necessary to identify the part. Components and parts comprising a major end item are listed alphabetically. Assemblies and subassemblies are in alphabetical sequence with their components listed alphabetically immediately below the assembly listing.
- (2) *Maintenance function.* This column indicates the various maintenance functions allocated to the echelon capable of performing the operations.
 - (a) *Service.* To clean, to preserve, and to replenish fuel and lubricants.
 - (b) *Adjust.* To regulate periodically to prevent malfunction.
 - (c) *Inspect.* To verify serviceability and to detect incipient electrical or mechanical failure by scrutiny.
 - (d) *Test.* To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc.
 - (e) *Replace.* To substitute service assemblies, subassemblies, and parts for unserviceable components.
 - (f) *Repair.* To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes but is not limited to, inspecting, cleaning, preserving,

adjusting, replacing, welding, riveting, and straightening.

- (g) *Align.* To adjust two or more components of an electrical system so that their functions are properly synchronized.
 - (h) *Calibrate.* To determine, check, or rectify the graduation of an instrument, weapon, or weapons system, or components of a weapons system.
 - (i) *Rebuild.* To restore an item to a standard as near as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements using original manufacturing tolerances, and/or specifications and subsequent reassembly of the item.
 - (j) *Overhaul.* To restore an item to completely serviceable condition as prescribed by serviceability standards developed and published by heads of technical services. This is accomplished through employment of the technique of "Inspect and Repair Only as Necessary" (IROAN). Maximum utilization of diagnostic and test equipment is combined with minimum disassembly of the item during the overhaul process.
- (3) *1st, 2d, 3d, 4th, 5th echelon.* The symbol X indicates the echelon responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated operation.

(4) *Tools required.* This column indicates code assigned to each individual tool equipment, test equipment, and maintenance equipment referenced. The grouping of codes in this column of the maintenance allocation chart indicates the tool, test, and maintenance equipment required to perform the maintenance function.

(5) *Remarks.* Entries in this column will be utilized when necessary to clarify any of the data cited in the preceding columns.

c. Columns in the allocation of tools for maintenance functions chart are as follows:

(1) *Tools required for maintenance functions.* This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

(2) 1st, 2d, 3d, 4th, and 5th echelon. A dagger (†) symbol indicates the echelons allocated the facility.

(3) *Tool code.* This column lists the tool code assigned.

2. Mounting Hardware.

The basic entries of the maintenance allocation chart do not include mounting hardware such as screws, nuts, bolts, washers, brackets, and clamps, etc.

3. Maintenance by Using Organizations.

When this equipment is used by signal service organizations organic to theater headquarters or communication zones to provide theater communications, those maintenance functions allocated up to and including fourth echelon are authorized to the organization operating this equipment.

MAINTENANCE ALLOCATION CHART (AN/FRR-40)

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
RECEIVING SET, RADIO AN/FRR-40	service		X				1, 3	Operational Check Preventive Maintenance
	adjust		X					
	inspect		X					
	replace		X					
	repair		X	X				
CABINET ELECTRICAL EQUIPMENT CV-1119/U	align		X				1, 2, 7, 8, 9, 11, 12, 13, 14	Operational Check Preventive Maintenance
	calibrate				X		1, 2, 6, 7, 8, 9, 10, 11, 12, 13, 14	
	rebuild					X	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	
	replace		X					
	repair			X		X		
CONVERTER, SINGLE, SIDEBAND CV-157/URR	rebuild							See Separate MAC
	replace		X					See Separate MAC
	repair			X		X		See Separate MAC
RECEIVER, RADIO R-390/URR	rebuild							See Separate MAC
	replace		X					
	repair			X				
RECEIVER, RADIO R-390/URR	rebuild					X		See Separate MAC
	replace							
	repair							

ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTIONS (AN/FRR-40)

(1) TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	(2)					(7) TOOL CODE	(8) REMARKS
	1ST ECH	2ND ECH	3RD ECH	4TH ECH	5TH ECH		
AN/FRR-40 (continued)							
TOOL EQUIPMENT TK-87		+			+	1	
MULTIMETER TS-352/U		+		+	+	2	
TEST SET, ELECTRON TUBE TV-7/U		+		+		3	
TEST SET, ELECTRON TUBE TV-2/U					+	4	
AUDIO OSCILLATOR TS-382/U		+		+	+	5	
SPECTRUM ANALYZER TS-723/U				+	+	6	
TOOL EQUIPMENT TK-88		+		+	+	7	
MULTIMETER ME-30/U		+		+	+	8	
HF SIGNAL GENERATOR AN/URM-25		+		+	+	9	
FREQUENCY METER FR-67/U				+	+	10	
TRANSFORMER CN-16/U		+		+	+	11	
OSCILLOSCOPE OS-84/U		+		+	+	12	
MULTIMETER ME-26/U		+		+	+	13	
FREQUENCY METER AN/URM-32		+		+	+	14	

MAINTENANCE ALLOCATION CHART (AN/FRR-41)

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
RECEIVING SET, RADIO AN/FRR-41	service		X				1, 3	Operational Check Preventive Maintenance
	adjust		X					
	inspect		X					
	replace		X					
	repair		X					
	align			X				
	calibrate				X		1, 2, 7, 8, 9, 11, 12, 13, 14	
	rebuild					X	1, 2, 6, 7, 8, 9, 10, 11, 12, 13, 14	
							1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	
CONVERTER SINGLE SIDEBAND CV-157/URR	replace		X					See Separate MAC
	repair			X				
	rebuild					X		
CABINET, ELECTRICAL EQUIPMENT CY-1119/U	replace		X					See Separate MAC
	repair			X				
	rebuild					X		
RECEIVER, RADIO R-390/URR	replace		X					See Separate MAC

ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTIONS (AN/FRR-41)

(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)
TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS		1ST ECH	2ND ECH	3RD ECH	4TH ECH	5TH ECH	TOOL CODE	REMARKS
AN/FRR-41 (continued)								
TOOL EQUIPMENT TK-87			+		+	+	1	
MULTIMETER TS-352/U			+		+		2	
TEST SET, ELECTRON TUBE TV-7/U			+		+		3	
TEST SET, ELECTRON TUBE TV-2/U						+	4	
AUDIO OSCILLATOR TS-382/U			+		+	+	5	
SPECTRUM ANALYZER TS-723/U			+		+	+	6	
TOOL EQUIPMENT TK-88			+		+	+	7	
MULTIMETER ME-30/U			+		+	+	8	
RF SIGNAL GENERATOR AN/URM-25			+		+	+	9	
FREQUENCY METER FR-67/U					+		10	
TRANSFORMER CN-16/U			+		+	+	11	
OSCILLOSCOPE OS-8A U			+		+	+	12	
MULTIMETER ME-26/U			+		+	+	13	
FREQUENCY METER AN/URM-32			+		+	+	14	

APPENDIX II
BASIC ISSUE ITEMS
Section I. INTRODUCTION

1. Scope

a. This appendix lists items supplied for initial operation and for running spares. The list includes tools, accessories, parts, and material issued as part of the major end item. The list includes all items authorized for basic operator maintenance of the equipment. End items of equipment are issued on the basis of allowances prescribed in equipment authorization tables and other documents that are a basis for requisitioning.

b. Columns are as follows:

- (1) *Source, maintenance, and recoverability code.* Not used.
- (2) *Federal Stock Number.* This column lists the 11-digit Federal stock number.
- (3) *Designation by model.* Not used.
- (4) *Description.* Nomenclature or the standard item name and brief identifying data for each item is listed in this column. When requisitioning, enter the nomenclature and description.
- (5) *Unit of issue.* The unit of issue is the supply term by which the individual item is counted for procurement, storage, requisitioning, allowances, and issue purposes.

- (6) *Expendability.* Expendable items are indicated by the letter X; nonexpendable items are indicated by NX.
- (7) *Quantity authorized.* Under "Items Comprising an Operable Equipment," the column lists the quantity of items supplied for the initial operation of the equipment. Under "Running Spares and Accessory Items," the quantities listed are those issued initially with the equipment as spare parts. The quantities are authorized to be kept on hand by the operator for maintenance of the equipment.
- (8) *Illustration.* The "Item No." column lists the reference symbols used for identification of the items in the illustration or text of the manual.

2. References

Additional instructions concerning maintenance of the equipment are contained in:

Operator's Manual:

TM 11-5820-357-10, Receiver, Radio R-390/URR.

Basic Issue Items List:

TM 11-5820-214-10P, Converter, Single Sideband CV-157/URR.

Section II. FUNCTIONAL PARTS LIST (AN/FRR-40)

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO	(9) ITEM NO
			ITEMS COMPRISING AN OPERABLE EQUIPMENT					
			RECEIVING SET RADIO AN FRR-40					
	5820-545-7325		RECEIVING SET, RADIO AN/FRR-40	ea	NX			
	Ord thru AGC		TECHNICAL MANUAL TM 11-649	ea	X	2		
	5820-503-0801		CABINET ELECTRICAL EQUIPMENT CV-1119/U	ea	NX	1		
	5820-503-2594		CONVERTER, SINGLE SIDEBAND CV-157/URR	ea	NX	1		
	5820-039-7260		INSTALLATION KIT ELECTRONIC EQUIPMENT MK-352/FRR-40	ea	X	1		
	5820-503-1242		RECEIVER, RADIO R-390 URR	ea	NX	1		
			INSTALLATION KIT, ELECTRONIC EQUIPMENT MK-352/FRR-40					
	5935-201-2410		ADAPTER, CONNECTOR UG-971/U: SigC dwg No. SC-C-106728	ea	X	1		CP1101
	5935-660-4302		CONNECTOR, PLUG, ELECTRICAL UG-573B/U	ea	X	1		PI101
	5920-240-4114		FUSE, PLUG: 10 amp; 125 v; MIL type F14D10R0A	ea	X	2		F1101 F1102
	5820-509-0953		LEAD ELECTRICAL: 1/8 in tinned copper braid 16 in lg; No. 10 term lug 1st end; 2nd end tinned; Monmouth Elec part/dwg No. ME-B-648-A	ea	X	1		W1101
	5993-571-8059		LEAD, ELECTRICAL: 1/8 in tinned copper braid; No. 6 lug term 1st end; No. 10 lug term 2nd end; Monmouth Elec part/dwg No. ME-B-648-4	ea	X	8		W1102
	5310-208-1971		NUT, PLAIN, SQUARE: steel; cadpl; 1/4 -20 UNC-2B thd; Spec FF-B-571 type B Style 2	ea	X	8		H1105
	5820-503-1173		PANEL BLANK: aluminum; Navy dwg REL3F225 Size A	ea	X	1		A1105
	5820-506-8620		PANEL, BLANK: aluminum; gray E finish; Navy dwg RE23F225 Size C	ea	X	1		A1106
	5820-509-0944		PANEL, BLANK: aluminum; gray E finish; Navy dwg RE23F225 Size G	ea	X	3		A1107 A1108 A1109

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO	(9) ITEM NO
			AN/FRR-40 (continued)					
	5820-509-0949		PLATE IDENTIFICATION: aluminum inscribed Receiving Set Radio AN/FRR-40; SigC dwg No. SC-D-17269-2	ea	X	1		N1101
	5820-205-1046		PLATE, INSTRUCTION: aluminum; inscribed; "Caution Read Instructions Packed With Equipment Before Using: SigC dwg No. SC-D-17269-1	ea	X	1		N1102
	5305-506-8709		SCREW, MACHINE: steel; cad pl; pan H; slotted dr; Z-56 thd 3/16 in lg; MIL MS-35223-2	ea	X	8		H1101
	5305-506-8743		SCREW, MACHINE: steel; cad pl; pan H; slotted dr; 1/4-20 UNC thd 5/8 in lg; MIL MS-35223-80	ea	X	8		H1102
	5305-550-9346		SCREW, MACHINE: brass; cad pl; pan H; slotted dr 6-32 NC thd 3/8 in lg; MIL MS-35229-28	ea	X	2		H1103
	5305-506-8738		SCREW, MACHINE: brass; cad pl; pan H; slotted dr; 10-32 thd 3/8 in lg; MIL MS35230-61	ea	X	2		
	5310-595-5974		WASHER, FLAT: rd; light steel; cad pl; Spec FF-W-92 type A class A, grade 1	ea	X	8		H1106
	5310-209-3979		WASHER, LOCK: med steel; cad pl; helical split; 1/4 in nom bolt size; MIL-MS-35338-44	ea	X	8		H1107
			RUNNING SPARES AND ACCESSORY ITEMS					
			RECEIVING SET, RADIO AN/FRR-40					
			INSTALLATION KIT, ELECTRONIC EQUIPMENT MK-352/FRR-40					
	5935-281-2410		ADAPTER, CONNECTOR UG-971/U: SigC dwg No. SC-C-106728	ea	X	1		
	5935-660-4302		CONNECTOR, PLUG, ELECTRICAL UG-573B/U	ea	X	1		
	5920-240-4114		FUSE, PLUG: 10 amp 125 v; MIL type F14D10ROA	ea	X	5		

Section III. FUNCTIONAL PARTS LIST (AN/FRR-41)

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO.	(9) ITEM NO.
			ITEMS COMPRISING AN OPERABLE EQUIPMENT					
			RECEIVING SET RADIO AN/FRR-41					
	5820-039-7339		RECEIVING SET RADIO AN/FRR-41	ea	NX			
	Ord thru AGC		TECHNICAL MANUAL TM 11-649	ea	X	2		
	5820-503-0801		CABINET, ELECTRICAL EQUIPMENT CY-1119 U	ea	NX	1		
	5820-503-2594		CONVERTER SINGLE SIDEBAND CV-157 URR	ea	NX	1		
	5820-039-7339		INSTALLATION KIT ELECTRONIC EQUIPMENT MK-354 FRR-41	ea	X	1		
	5820-503-1242		RECEIVER, RADIO R-390 URR	ea	NX	1		
			INSTALLATION KIT ELECTRONIC EQUIPMENT MK-354 FRR-41					
	5935-201-2410		ADAPTER CONNECTOR UG-571/U; SigC dwg No. SC-C-106728	ea	X	2		CP1201 CP1202
	5935-660-4302		CONNECTOR, PLUG, ELECTRICAL UG-579B/U	ea	X	2		P1201 P1202
	5920-228-4484		FUSE, PLUG: 15 amp; 125 v; MIL type F14D15ROA	ea	X	2		F1201 F1202
	5820-509-0953		LEAD, ELECTRICAL: 1/8 in tinned copper braid 16 in lg No. 10 lug term 1st end; 2nd end tinned; Monmouth Elec part/dwg No. ME-B-648-A	ea	X	2		W1201 W1202
	5995-571-8059		LEAD, ELECTRICAL: 1/8 in tinned copper braid; 6 in lg; No. 6 lug term 1st end; No. 10 lug term 2nd end; Monmouth Elec part/dwg No. ME-B-648-4	ea	X	2		W1203 W1204
	5310-208-1971		NUT, PLAIN SQUARE: steel; cad pl; 1/4-20 UNC 2 B thd; Spec FF-B-571 type B Style 2	ea	X	16		H1205
	5820-503-1173		PANEL, BLANK: aluminum; gray E finish; 1-23/32 in wd x 19 in wd x 0.005 in thk; Navy dwg RE23F225 Size A	ea	X	3		A1209 A1210 A1211

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS	
							FIGURE NO.	ITEM NO
			AN/FRR-41 (continued)					
	5820-509-0957		PANEL, BLANK: aluminum; gray E finish; 3-15/32 in wd x 19 in lg x 0.005 in thk; Navy dwg RE23F225 Size B	ea	X	2		A1212 A1213
	5820-506-8620		PANEL, BLANK: aluminum; gray E finish; 5-7/32 in w x 19 in lg x 0.005 in thk; Navy dwg No. RE23F225 Size C	ea	X	1		A1214
	5820-141-2981		PLATE IDENTIFICATION: aluminum; inscribed: "SC-D-17269-2 in w x 1/32 in thk; SigC dwg No. SC-D-17269-2	ea	X	1		N1201
	6130-205-0770		PLATE, INSTRUCTION: aluminum; inscribed: "Caution: Read Instructions Packed With Equipment Before Using:" 2-1/4 in lg x 7/8 in wd x 1/32 in thk; SigC dwg No. SC-D-17269-1	ea	X	1		N1202
	5305-506-8743		SCREW, MACHINE: steel; cad pl; pan H; slotted dr; 1/4-20 UNC thd 5/8 in lg; MIL MS35223-80	ea	X	16		H1202
	5305-506-8709		SCREW, MACHINE: steel; cad pl; pan H; slotted dr; 2-56 thd 3/16 in lg; MIL MS-35223-2	ea	X	8		H1201
	5305-550-9346		SCREW, MACHINE: brass; cad pl; pan H; slotted dr; 6-32 thd 3/8 in lg; MIL MS 35229-28	ea	X	2		H1204
	5305-506-8738		SCREW, MACHINE: brass; plain; pan H; slotted dr; 10-32 thd 3/8 in lg; MIL MS35230-61	ea	X	4		
	5310-595-5974		WASHER, FLAT: rd; light steel; cad pl; 1/4 in id 5/8 in od; Spec FF-W-92 type A Class A grade 1 light	ea	X	16		H1206
	5310-209-3979		WASHER, LOCK: med steel; cad pl; split helical; 1/4 in nom bolt size; MIL MS 35338-44	ea	X	16		H1207
			RUNNING SPARES AND ACCESSORY ITEMS					
			RECEIVING SET RADIO AN/FRR-41					
			INSTALLATION KIT ELECTRONIC EQUIPMENT MK-354/FRR-41					
	5935-201-2410		ADAPTER, CONNECTOR UG-571/U: SigC dwg No. SC-C-106728	ea	X	1		
	5935-660-4302		CONNECTOR, PLUG, ELECTRICAL UG-573B/U	ea	X	1		
	5920-240-4114		FUSE, PLUG: 10 amp; 125 v; MIL type F14D10ROA	ea	X	5		

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NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

TM 11-649/T0 31R2-2FRR-221 RADIO RECEIVING SETS—1955